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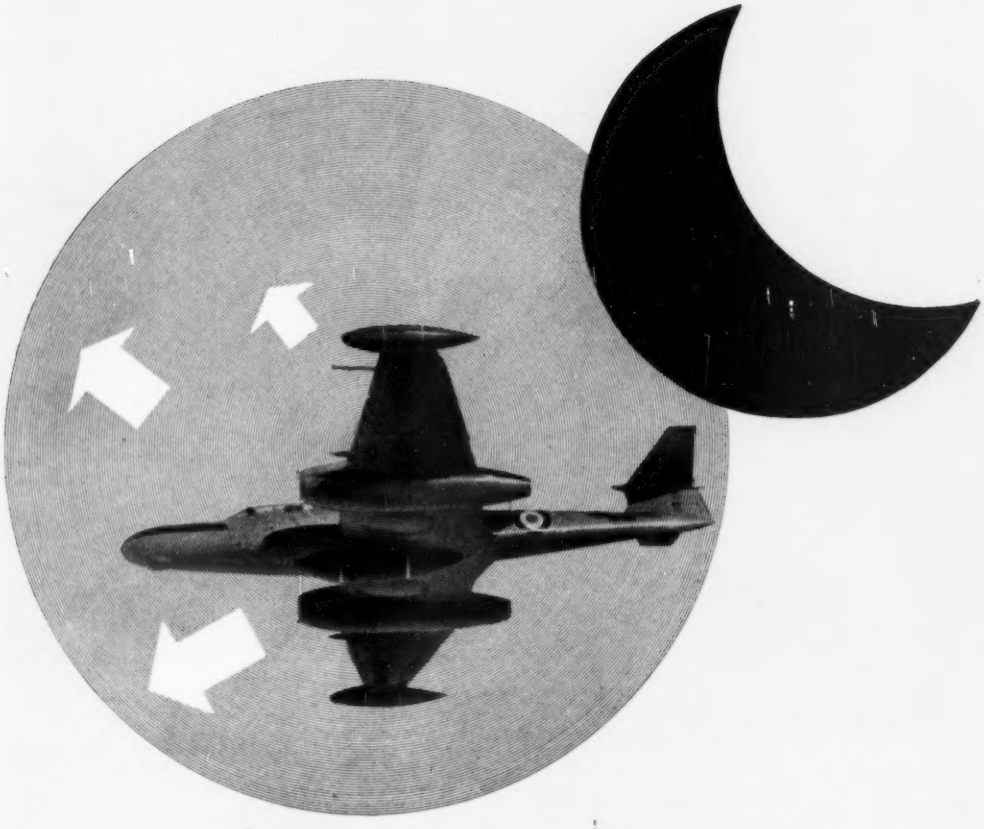

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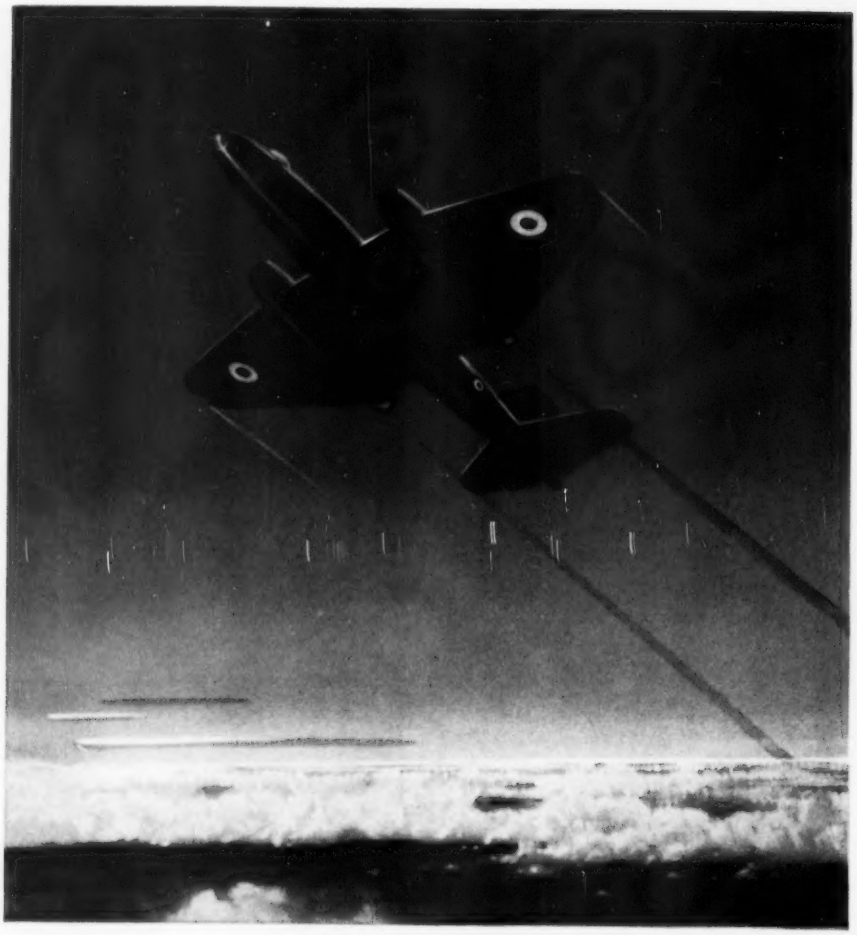

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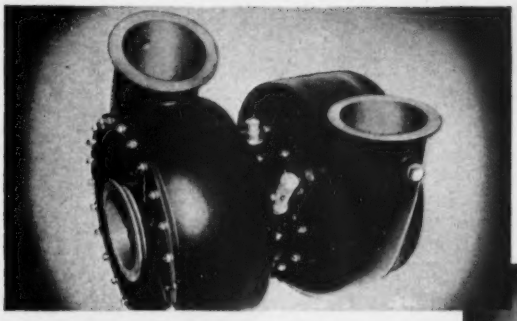

Cold Air Units

are installed in the air conditioning systems of pressurized aircraft to cool the ventilating air supplied to the cabins. Using the ventilating air as the working medium, these units are simple in operation and require little maintenance. Godfrey Cold Air Units are installed in the Comet, Viscount, Hermes, and many military aircraft.

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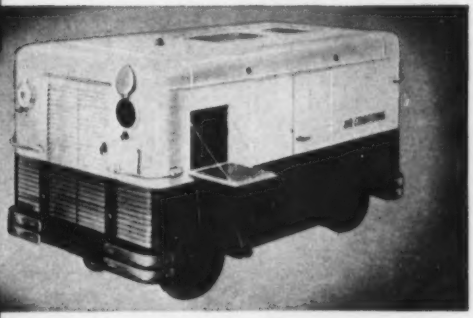

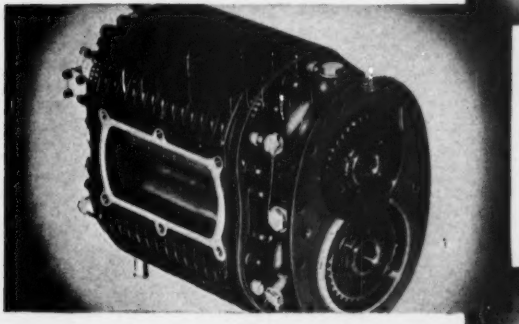

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for pressurizing and ventilating aircraft cabins. Single stage and two stage models are in production —all operating on the Roots principle. Simplicity, reliability and economy in operation are the outstanding features of these superchargers. As an example, the Type 15 supplied for the B.O.A.C. Argonaut has an overhaul life of 2400 hours, approved by the A.R.B.

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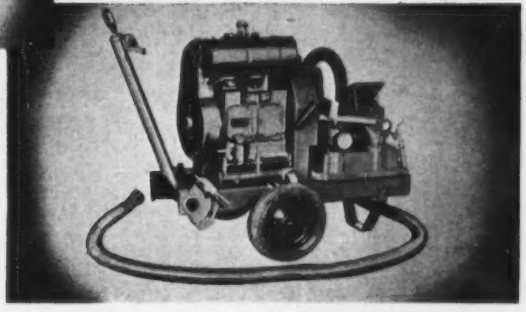
We are specialists in the design of pressure cabin testing trolleys. The Mk. 1c illustrated employs an air cooled twin petrol engine driving a Godfrey Roots type blower. This trolley, designed for pressure testing medium size aircraft cabins, is robust, reliable and simple in operation. Typical performance: 70 cfm of air at pressures up to 10 psi.



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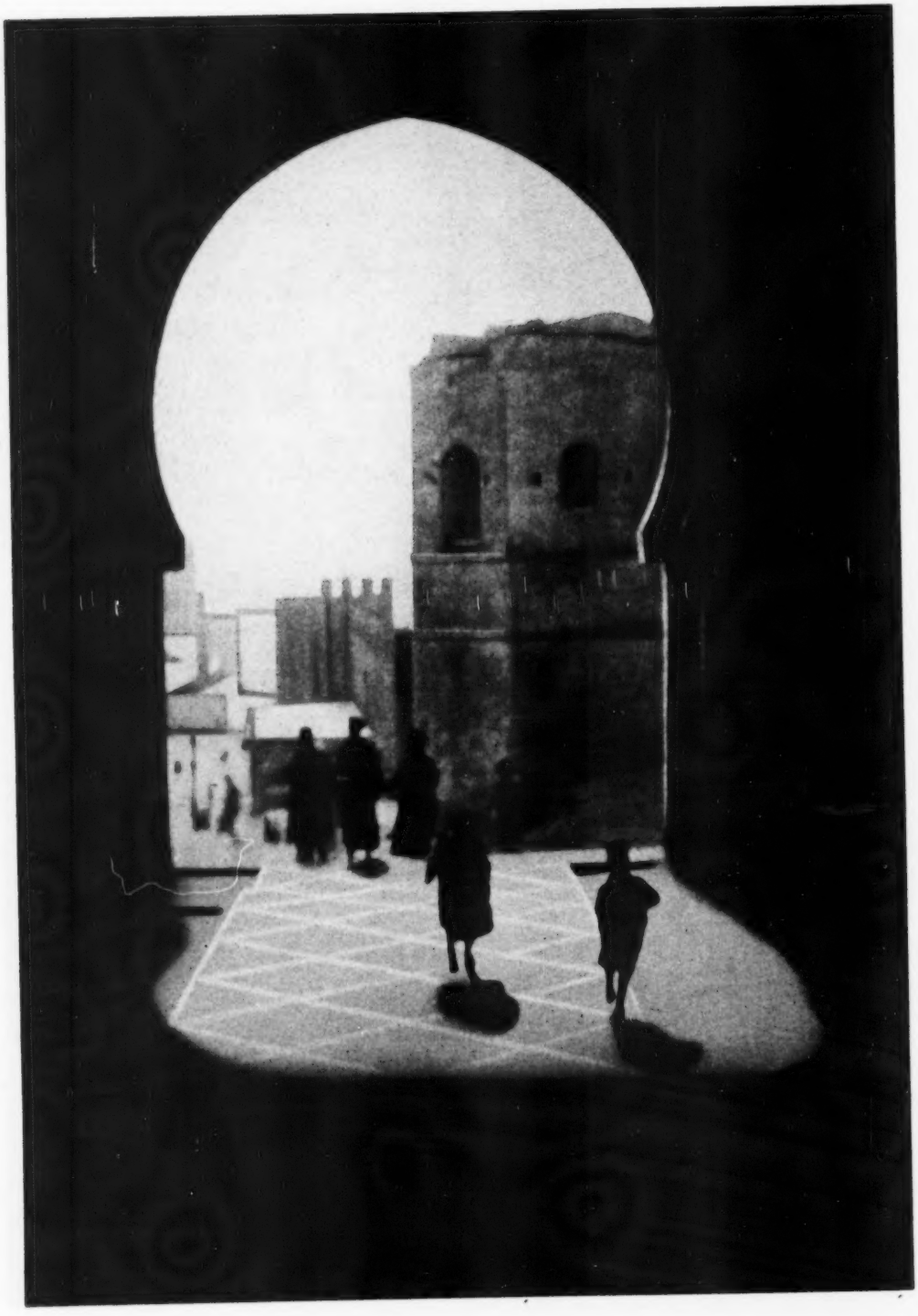

To India and the Far East...

a saga of British Airmanship

The first Empire air route pioneered by Imperial Airways — a predecessor of B.O.A.C. — was between Egypt and India.

Service on the Cairo to Basra sector began in January, 1927, with de Havilland 3-engined *Hercules* passenger and freight airliners. In March, 1929, the first regular through service left London for Karachi, cutting travel time to one week compared with three by ship. Gradually the route was extended. By 1933 it had reached Singapore.

Further developments began in October, 1935, with experimental flights linking Hong Kong with the main U.K./Australia trunk route via Penang, Saigon and Hue. From December, 1937, the Hong Kong " branch " connected with the trunk route at Bangkok instead of Penang, and the service flew to Hong Kong via Hanoi and Port Bayard. This saved 1,000 miles and reduced the scheduled time from London to Hong Kong to 8½ days.

In 1937 Imperial Airways introduced "C" Class 4-engined flying boats on the Commonwealth routes. By October they were flying from the United Kingdom to Karachi on a schedule which almost halved the 1929 time of 7½ days. By July of the following year flying boats were spanning the entire route from the United Kingdom to the Far East.

Shortly after the outbreak of war Imperial Airways and British Airways were amalgamated to form the British Overseas Airways Corporation. B.O.A.C. maintained vital air communications, with unarmed aircraft, in many theatres of operation. With the Japanese invasion of Malaya and Burma, Calcutta became the Eastern terminal of British air services.

In 1946 the routes to Singapore and Hong Kong were re-opened with flying boats ; two years later the service was extended to Japan for the first time. The first British commercial air service from the United Kingdom to Ceylon was opened by B.O.A.C. in 1947. The following year the Corporation introduced another new service across the Indian Ocean, linking Ceylon with Singapore.

The progressive withdrawal of flying boats from the Far Eastern and Australian routes, and their replacement by modern landplanes, enabled B.O.A.C. to introduce faster and more frequent flights on these routes. *Argonaut* airliners were put in service on the Hong Kong and Japan routes in August, 1949, and subsequently to the Middle East, Pakistan, India, Ceylon and Malaya. In addition to passenger services, B.O.A.C. operates *York* freighter aircraft between London and Singapore.

When *Comet* jetliners are introduced on the route between London and Singapore shortly, the journey time for the 7,700-mile flight will probably be reduced to about 30 hours. This service will operate through Pakistan, India, Burma or Siam.

Looking back over this quarter of a century of solid achievement in the operation of air services to the East, B.O.A.C. and its predecessors can feel justly proud. We now look forward with confidence to a future in which yet faster and even more comfortable air services will be provided.

B.O.A.C. TAKES GOOD CARE OF YOU TO ALL SIX CONTINENTS

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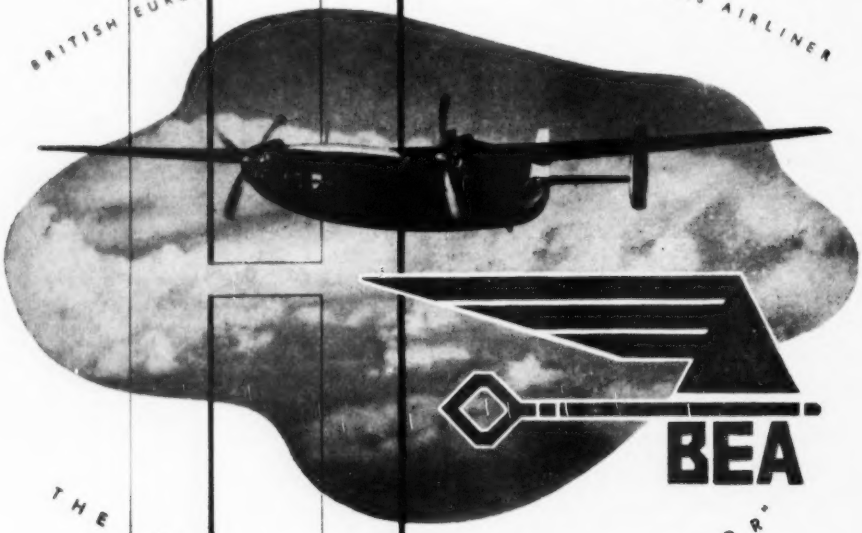
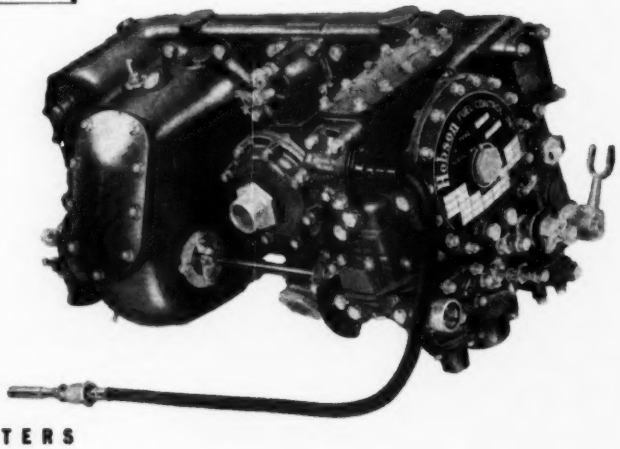


THE D.H. AIRSPEED "AMBASSADOR"

The latest addition to the fleet of aircraft in service with the B.E.A., the handsome Ambassador is now in regular operational use.

Its two Bristol Centaurus engines are fitted with Hobson B.C.15 Injection Carburetters—one more indication of the wide esteem in which Hobson equipment is held by aircraft and engine designers throughout the industry.



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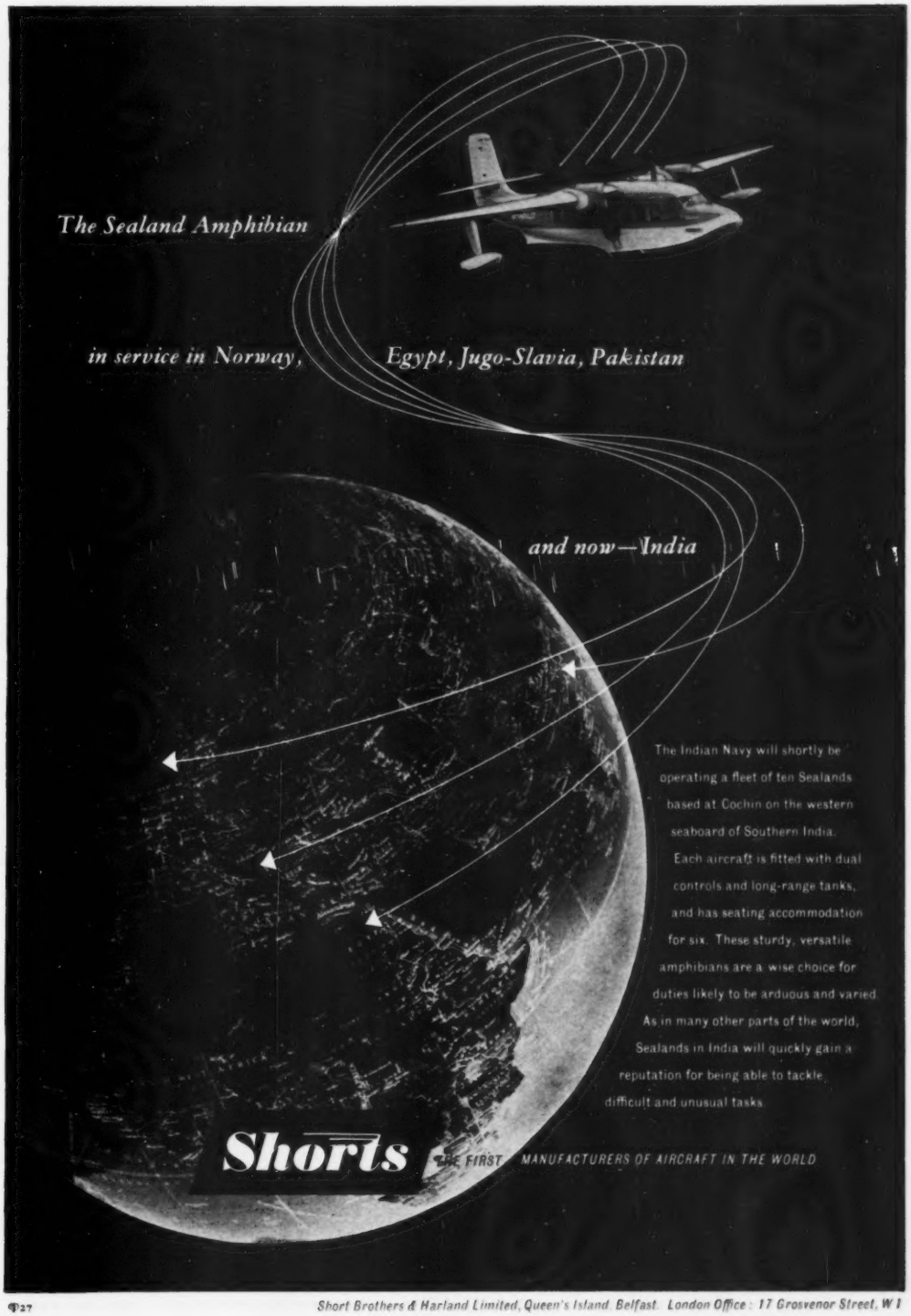
The Sealand Amphibian
in service in Norway, Egypt, Jugo-Slavia, Pakistan
and now—India
The Indian Navy will shortly be operating a fleet of ten Sealands based at Cochin on the western seaboard of Southern India. Each aircraft is fitted with dual controls and long-range tanks, and has seating accommodation for six. These sturdy, versatile amphibians are a wise choice for duties likely to be arduous and varied. As in many other parts of the world, Sealands in India will quickly gain a reputation for being able to tackle difficult and unusual tasks.
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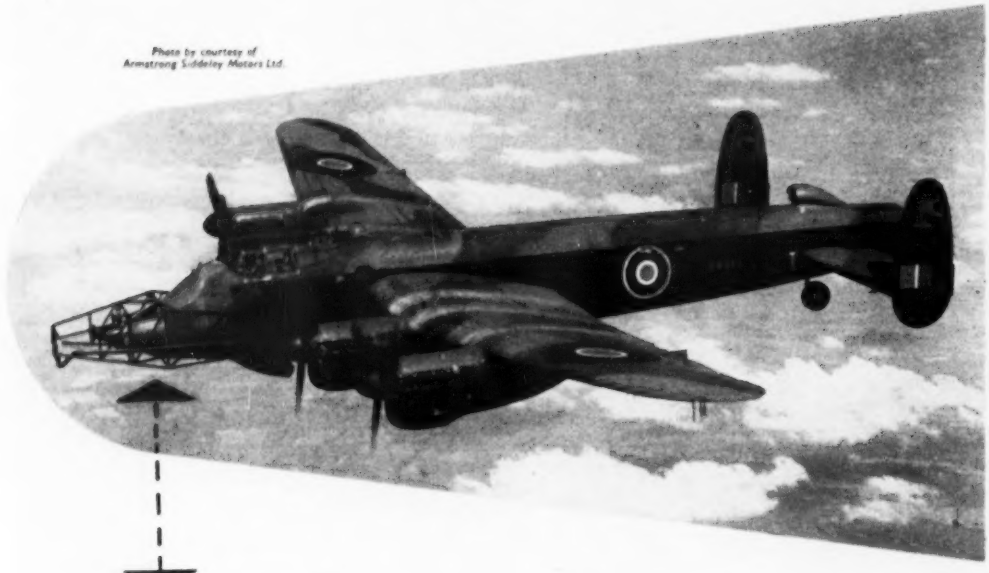
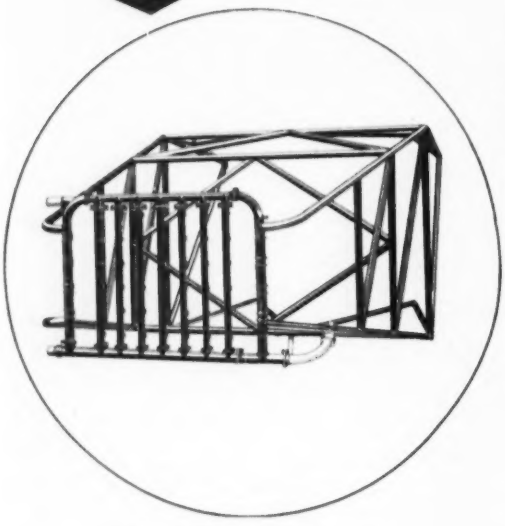


Photo by courtesy of Armstrong Siddeley Motors Ltd.



A one-off anti-icing test rig made for Armstrong Siddeley Motors Ltd., for use on their Avro Lancaster flying test bed

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We have just spent a sleepless night trying to find superlatives that would adequately describe the New Pacitor fuel contents gauge. We occasionally wondered to ourselves what was the matter with the old Pacitor. Wasn't it a wonderful little gauge, capable of giving accurate readings unaffected by altitude, temperature or aircraft position? It was. Then why the new one? Can it also be used to grind coffee when the aircraft is on the ground? Apparently not. It still only records the contents of each tank individually or all tanks combined on the same dial, but it does that even more accurately. And what is equally important, it is lighter, smaller and easier to service. Well, we didn't find any superlatives but maybe these comparatives will do.

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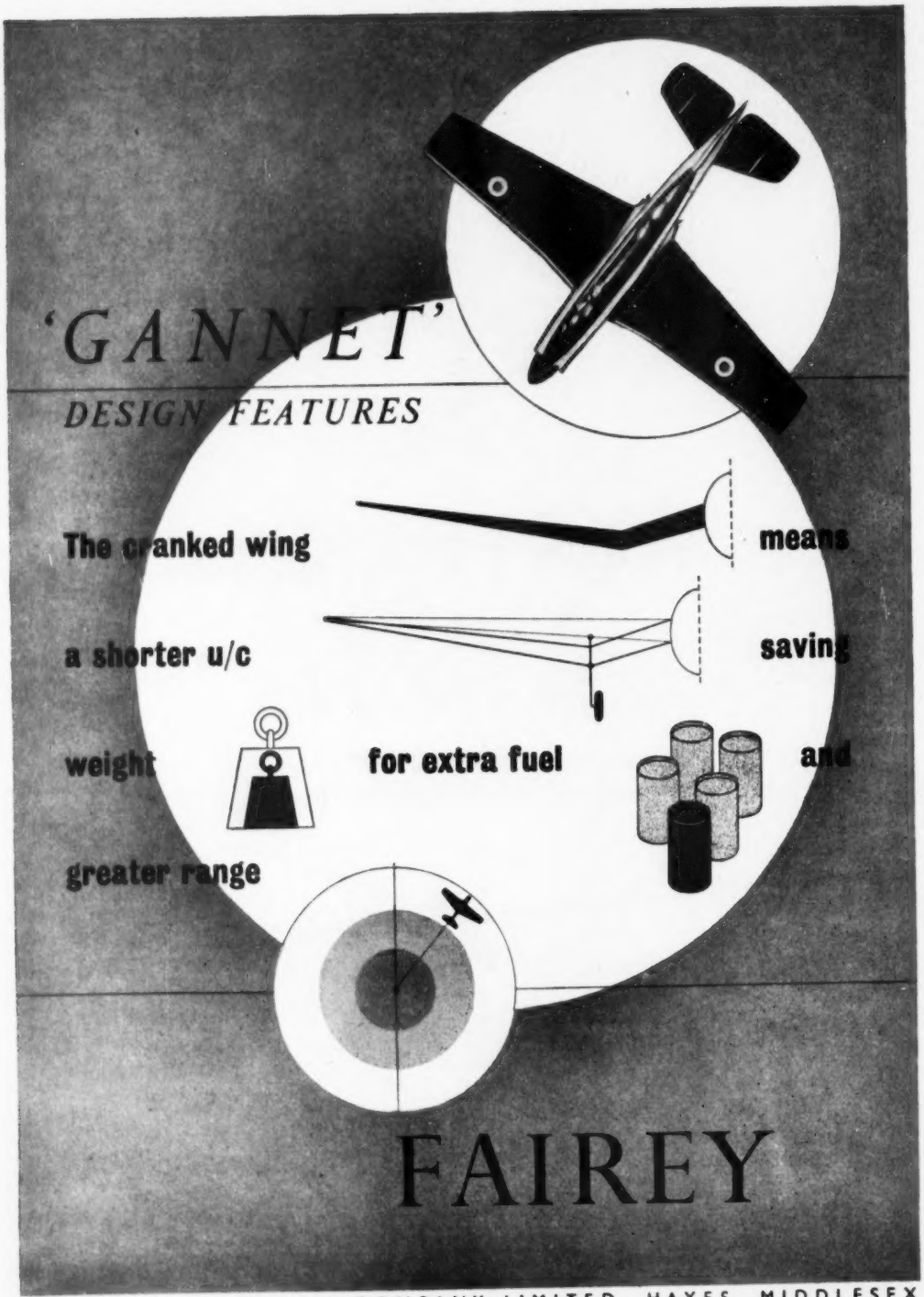

THE FAIREY AVIATION COMPANY LIMITED, HAYES, MIDDLESEX

FLIGHT
and
AIRCRAFT ENGINEER

First Aeronautical Weekly in the World

Founded 1909

No. 2280 Vol. LXII. FRIDAY, 3 OCTOBER, 1952

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Editorial, Advertising and Publishing Offices:
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STAMFORD STREET,
LONDON, S.E.1.

Telegrams, Flightpres, Sedist, London.
Telephone, Waterloo 3333 (60 lines).

Branch Offices:
COVENTRY
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A Real Fighting Force

NEVER in peace-time has the fighting spirit of the R.A.F. been more apparent than it is today; and nowhere is it more noticeable than in Germany. The reasons are very clear when one is privileged (as were we ourselves on the recent NATO exercises) to live, fly, eat and drink with the men of the 2nd A.T.A.F.

Though it must not be supposed that aggression would necessarily strike at their particular sector of NATO's 6,000-mile frontier, these men are, nevertheless, keenly aware that they are in the front line; so everyone from the air marshal down is busy keeping himself at operational pitch. Live firing, intercepting, reconnoitring and quick changing from one base to another comprise the daily round, and practices, exercises and schemes are routine.

In peace-time, of course, a man may shoot well, fly accurately and move quickly without having in himself any of that intangible amalgam of courage, comradeship and dash which is the very life-blood of a tactical air force at war. It is necessary, therefore, that he should be imbued with this spirit, which we call the fighting spirit.

For this task the R.A.F. has the very best men—young, but senior, officers who command respect not only by the D.S.O.s and D.F.C.s on their battledress, but by their strong, though widely differing, personalities. These men lead by example, and it is not by mere chance that they find themselves in appointments which give them full scope for their particular qualities and temperaments.

As for resourcefulness, we need only pass on a small anecdote lately told to us in Germany: In the process of hacking out a new R.A.F. airfield from forest land many saplings had to be uprooted, and when a certain very famous R.A.F. group captain took command of the base he found them strewn around, doomed to rot. Without demur he turned out every able bodied man, woman and child on the station to replant them in a copse. So does the R.A.F. spirit flourish—as, we hope, will the copse.

Ups and Downs

A WEEK ago we were applauding B.O.A.C.'s achievement in making a clear profit for the year 1951/52, which was, on the whole, a good year for the airlines. The ups and downs of air transport are illustrated only too plainly by this week's announcement that B.E.A. lost over £1.4m during the same period. It would be easy enough to chide the less successful Corporation for losing public money, but the contents of the 73 pages, 10 appendices and five statements which comprise its remarkably detailed annual report and accounts tend, on the whole, to support the view that there is no single, simple way to cut the losses. And it remains regrettably likely that next year's report will also show a deficit, even though the introduction of low-fare services (domestic and international) and of the newer, more efficient aircraft may help to reduce it.

While there is no substitute for a clear profit—and B.E.A. will continue its efforts to achieve one—it must be noted that there is an artificial element in the published accounts of many airline companies. Air France and S.A.S., for example, both received revenue grants last year in excess of their declared profits. Some £267,000, or one-fifth of B.E.A.'s deficit, found its way back to the Exchequer in the shape of fuel tax—an economic burden which almost halves the revenue of domestic flights. A further £653,000 was paid out in salary-increases to members of the B.E.A. staff, while the introduction of the Elizabethan (which arrived too late to earn much revenue) added some £125,000.

Despite the deficit, there is a great deal of encouragement to be derived from B.E.A.'s operations last year, when the Corporation increased its traffic by 20 per cent and became the first airline outside America to carry over a million passengers. The figure was 1,135,579, representing 80 per cent of all those who fly in British aircraft. In this connection, some of the Corporation's less charitable critics might do worse than study this passage in the report: "If all persons of British nationality flying over the route networks served by B.E.A. flew on their own national airline . . . B.E.A.'s deficit would have been eliminated two years ago."

THE FIRST GUIDED MISSILE

—was a British Invention: Some Facts that Deserve to be Placed on Record

By PROFESSOR A. M. LOW

THE distinguished author of this article is, as he puts it, "roused to fury" whenever he hears Germany, America or any other foreign country credited with the invention of the pilotless, radio-controlled aircraft. The original conception was entirely British—and Prof. Low should know, for he was responsible for it, not ten but 37 years ago. His recollections of the early experiments in the days of the R.F.C. make entertaining reading.

IT is amusing—or, if that is the wrong word, strange—to think that Britain originated the "flying bomb" in almost every detail. To be exact, the first flying torpedo was made in London by a specially chosen staff of the old Royal Flying Corps.

To me it is rather interesting to read accounts of these marvellous German (?) weapons, to be told that much of the technique was known in America, or in Russia, ten years ago—and then to be able to turn up my own records. They show photographs, and reports from the Air Ministry and the Munitions Inventions Department, all of which explain exactly what happened in the First World War when these flying bombs were made for defence against Zeppelins or for the bombing of enemy railways and camps from a distance.

What is even more quaint is that nearly every foreign country in the world claims to have invented the guided missile. They naïvely give the date of their invention as being "round about 1930" so that, for once, England seems to have plenty of time to spare. Fourteen years, to be exact! Perhaps it was because the English usually tend to neglect inventions until they are imported from abroad (rather painfully in this case) that nothing much was ever done in the old days.

The fact that in 1917 the R.F.C. experimental works designed an electrically steered rocket on principles almost identical with those used in the missile which did so much damage to our shipping in 1941 makes these revelations still more startling. Another wonderful German (?) invention! These rocket experiments were conducted under my own patents with the help of Cdr. Brock, a truly great man who lost his life at Zeebrugge. For that Mole attack I had prepared a radio-fired bomb device by which any one of a number of floating buoys could be selected and exploded by radio.

But it might be as well to begin at the beginning. In 1914 I gave a demonstration of the principles of television in London and, soon after war broke out, I was asked by the Ordnance College, Woolwich, if the same invention could be used to render gun-sites simultaneously visible at each end of a half-mile base. I made a number of fairly successful experiments and then out of the blue came a telephone message from General Caddell of the War Office. We must remember that in those days the R.F.C. was part of the Army and the staff consisted of a few experts such as Grahame-White, Moore-Brabazon and others housed in some odd top rooms at the War Office and conducted by Army officers mainly seconded from the Gunners and Sappers. It was long afterwards that they blossomed out into an embryo Air Ministry, always referred to by everybody as "Boio House"—after a famous quisling of that day.

General Caddell, General Pitcher and Sir David Henderson—who was then Director-General of Military Aeronautics, not so many years after the War Office had told Moore-Brabazon (now Lord Brabazon of Tara) that flying was useless to the army—had the idea that radio vision could be used to direct a flying bomb. I remember saying that I would think it over, but I stipulated, to the amusement of General Caddell, that I could do so happily only as a member of the R.F.C. Within four days I had been interviewed by Pelham Warner, who asked me where I had been to school, took not the faintest notice of my technical qualifications, and commissioned me on the spot as a second lieutenant.

General Caddell, an exceptionally original and unprejudiced man, was my "boss." He asked me what I wanted, so I gave him a list of the type of man, the kind of machinery and the names of three skilled men as officers. My second in command was a Capt. Poole, who owned a garage; my next was Lt. Bowen, a brilliant engineering designer; and my radio assistant was Lt. Whitton, who had dropped straight from Gamage's wireless department (yes, even in those days!) into the Army for this work.

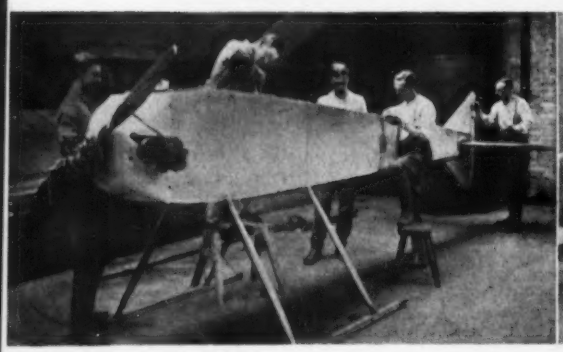
Events moved rapidly, although the military side of affairs was not very easy for me. Swords were worn in those days, but were difficult to obtain, so I got the Army and Navy Stores to straighten my grandfather's old cavalry sabre into the then modern shape. Never draw it in haste or sheathe it without honour, etc., etc., was almost as good a motto as *Per Ardua ad Astra*, or even the famous signal *Sursum Corda* ("Lift up your hearts") which was, I think, sent by General Brancker, who lost his life in 1930 in the airship R.101.

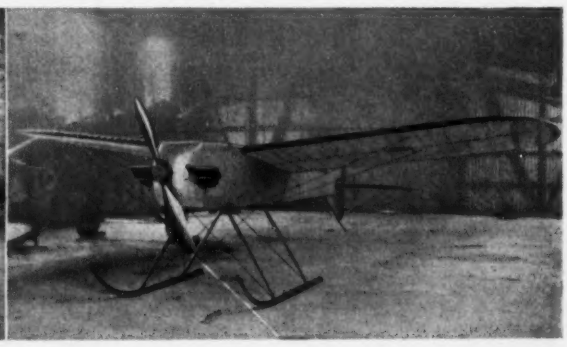
The whole affair was regarded as so "top secret" that a list of our full appointments had not even appeared in the *Gazette*. We were provided with a police and military guard; Sir David Henderson said to me, "Now, Low, we must think of some thundering lie to conceal the fact that we have a new weapon. Let us call it the A.T.; people will think it is meant as an aerial target."

General Pitcher briefed me by saying that his idea was that I should "sit with my feet on the mantelpiece thinking out ideas." Unfortunately for me this did not materialize, and—in my spare time—I designed a test gear for firing through the airscrew and made various experiments with the Pomeroy bullet, that very clever missile so constructed that it would explode on striking even the fine envelope of a Zeppelin. Some of these bullets had an unpleasant tendency to explode in the rifle breech, and I used to lean round a piece of boiler-plate before touching them off and hoping for the best. Pomeroy was a marvel; he made all his own materials with the help of his wife, working in the kitchen at home.

After preliminary experiments on the first A.T. receiving gear (we had to use coherers because valves were felt to be insufficiently

Several well-known constructors designed aircraft for the experiments: this graceful little monoplane, seen at an early stage of assembly and (right) completed, was a de Havilland conception. The engine, a flat twin designed by Granville Bradshaw, developed about 35 h.p. The chordwise lines under the wing are not ribs, but aerial wires; others are on the side of the fuselage. Interference from the ignition system was a difficulty.





(Left) With uniforms including the famous R.F.C. jacket usually known by one or other of two expressive names—a group at the Feltham "mystery" factory where the pilotless aircraft were developed. The author is seated in the centre of the group. In the right-hand photograph, the late Capt. Poole is seen at the transmitter, with his hand on the control keys. This equipment was duplicated, as a precaution against failure.

developed at that time) we were moved to Brooklands and housed in a special shed next to the old Bluebird Café on the Aerodrome. From there we went to a fairly well constructed works at Feltham, where we arrived with such ancient machinery that most nights were spent in frantic repairs. But we had about forty well-trained men and were able to continue the experiments by transmitting to and from balloons and ancient aircraft flying at Hounslow.

On one occasion, I recollect, we had difficulty in getting back to the flying ground and as we hung in the wind at our maximum speed of about 90 m.p.h. I was able to watch the ambulance coming from its shed in readiness for our landing. Actually we alighted safely, but I found it extraordinarily difficult to concentrate upon my apparatus and forget to wind in a long trailing-aerial, which gaily tore down most of the telephone wires in the neighbourhood. I can still see painted on the roof of a little chapel near the aerodrome the ominous words—"Prepare to meet thy God"! Those were very experimental days. Before practising night landings pilots used to tip the stoker at a local factory to make plenty of flame.

In 1916 or thereabouts, technical departments were very military. One famous Sapper general came to inspect our works and I recollect his touching the cylinders of an engine with his cane and remarking—"The sparking plugs I suppose, my boy?" General Brancker came to see us with his usual bustling and kindly efficiency and I asked him (meaning it quite politely and wanting to know into how much detail I should enter), "Do you know much about these things, sir?" Fastening his famous eye-glass firmly, he glared at me and replied, "What the hell do you think I came here for if I don't?" After a pause he added, with a charming smile, "As a matter of fact, I don't know a damn thing."

Our apparatus was rather crude and we had nothing upon which to base it. We made clocks which were so delicate that the seconds-hand could operate a switch on ruby rollers; we made signalling machines for the Admiralty which no one could read without the proper key; and all the time we were developing our real job, the radio-controlled torpedo which would be fitted with an electrical gyroscope.

The principle of the radio part of the missile was that of a time-switch working in fractions of a second and so constructed that unless the enemy knew the exact time taken for each signal—up-down, left-right, half speed to the engine, and explode—they could not interfere; and, what is more, the exact time of transmission of these signals was also keyed by a letter-lock number system afterwards applied to some of the radio-operated mines round the coast. Modern technicians must remember that in those days accurate radio-tuning was virtually impossible. The design was, of course in no way similar to the dirigible toy using a rotary switch, which the enemy could have controlled as well as ourselves.

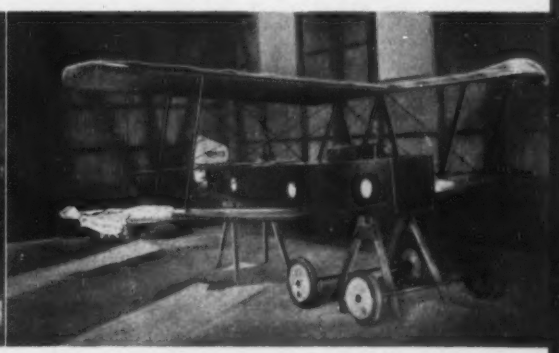
Some time after these original tests we built a tuned system which was applied to the control of wireless-operated motor patrol boats; all these inventions were long before the days of the Queen Bee target aircraft and the radio-controlled battleship experiments by the Admiralty. The Naval department is prominent in my mind for, having received two "mentions," I was transferred to the R.N.V.R. as a lieutenant-commander, only two days later to be again transferred, this time to the newly formed R.A.F.

Our works often had queer things sent to us for test, including "land torpedoes," but nothing deflected our main aim. We spent months trying to avoid radio interference from our first engine, an old rotary of the Gnome type. Then we substituted a horizontal two-stroke and finally a beautiful opposed engine made by that outstanding designer Granville Bradshaw. The fuselage was a matter of grave consideration, for we wanted stability without a gyro if possible. Machines were made by the Royal Aircraft Factory, by Sopwiths (with the help of Hawker) and finally by de Havillands, who produced a beautiful little monoplane.

At long last we achieved a semblance of reliability and, after immense preparations a cavalcade set forth for Upavon. We had first taken the rotary-engined monoplane but now had the latest result of what was known as the R.F.C. Experimental Works. The control was housed in a lorry and from this lorry extended two long launching rails with a multiplying gear driven by an air cylinder and a compressor operated from the engine of the lorry itself. Notice that we even had compressed-air launching, quite fifteen years before the introduction of the method was claimed by the American Navy. Upavon in those days was far from comfortable. People used to land there in slight fog thinking they were in France, and in the collection of sticks and wires then known as "military aircraft" such adventures were not very pleasant.

On the morning of the trial there was the inevitable humorous

The machines built for the experiments were of varied types; some were completed, and others were abandoned for one reason or another The aerial wires are clearly visible on the fuselage and wings on the monoplane on the left. In the right-hand view is a Sopwith-designed biplane; the wing-tip damage was not sustained in flight, for the aircraft was never completed in this form. Note the four-wheel, tail-up undercarriage.



beginning. Upavon was a training school for the R.F.C., while the R.N.A.S. were at Netheravon across the valley. Round and round our aerodrome was flying a learner on his first solo, and upon a signal being given to him to land he made a reasonable approach but cut in again at the last moment for another try. This went on for half an hour; every time the pupil switched on before the landing and made another circuit. Flares were shot into the air, flags were waved; all to no effect until at last someone (I think it was General Caddell) said, "We'll have to shoot the —— down!"

When the learner had finally made up his mind, that part of the Plain was cleared by mounted police and I solemnly walked across to the lorry, accompanied by a glittering staff of brass-hats from Belgium, France and Italy, with a positive covey of our own generals. With me was Major (not then Sir Henry) Segrave, who had been lent to us by the War Office to direct the actual flying. I was only a miserable Observer, with one wing.

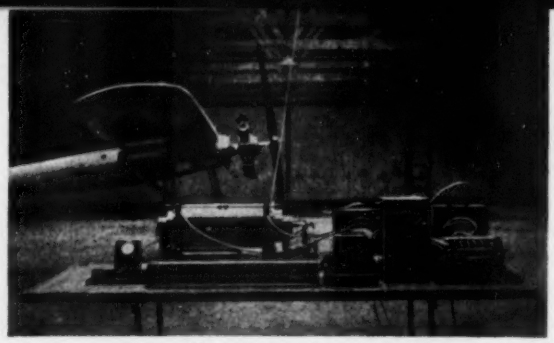
Segrave, a very charming personality, was keen on experiments. He always used to say that he was the world's worst pilot, having crashed so many machines while ferrying them from England to France. One of my earliest recollections of him was his asking me how he could get hold of a car in order to try his hand at motor racing!

General Caddell gave me the all-clear. I was sitting at the row of controls, with my fingers ready to play a kind of miniature piano. My flight-sergeant had his hand on the launching lever and, with a prayer, we let go. The first machine had engine failure on the runway and flopped ungracefully into the mud. Major Gordon Bell, afterwards known as the "Mad Major" by reason of his many crashes, remarked all too loudly, "I could throw my bloody umbrella farther than that!" Bell was a famous figure. He used to "loop" trembling observers within a few inches of the tarmac, once flew under the bridge at Brooklands, and on another occasion, after saying he could land in a hangar, only flew into one and out the other side—through the wall. On his most successful escapade he landed in a tree, under fire at St. Omer. The commanding officer was not far away and when he shouted, "What do you think you are doing?" Bell replied, with his quaint stammer, "I always l-l-l-land like that, sir" He was reduced in rank for what must have been quite the third time. No one could stifle his spirit and courage for long. A lovable and honourable man, he was killed a year or so afterwards.

Our next trial was better, for the machine took off, flew under control for a short time until, after a loop, the engine failed. Sitting innocently at the controls inside the lorry, I saw nothing of this but, hearing a shout, looked back—to see a large concourse of brass-hats running for their lives. This mystified me for an instant until, with an appalling crash, the A.T. landed about three yards from where I was sitting and buried most of our beautiful work in the ground. But it had flown and it had worked.

We used to test the bomb part with a petrol flare (no atomic warheads in those days!) and I still have a report from Sir Henry Norman, who was head of M.I.D., in which he stated that the problem of controlled flight without crew had been solved up to the limits of vision. What happened after vision was just as good but this was considered to be nobody's business, for we had arranged for a kind of parent aircraft to fly with it as a controller when necessary. Or should one say wind and gyro permitting?

During the early part of the experiment and after these tests, when various improvements were being considered, we were given what might be called odd jobs. I was sent to Paris to see a man who said he could raise iron girders in the air by means of a pocket



This aircraft, seen behind the transmitting equipment, was the very first of the series. It had a tubular metal fuselage, utilized the lower wings of a Sopwith Pup, and was powered with an engine of about 60 h.p. built by the Royal Aircraft Factory.

battery; and such was the state of technical knowledge in most high places at the time that I believe this claim was almost taken on trust. I was shown these and other experiments by Commandatore Binetti, the then Naval Attaché in Rome, an enthusiast who was devoting his life and efforts to serving the Allies.

The most surprising lesson learnt from our guided-missile achievement was that invention needs far more than success to make it successful In other words, it takes time for "operability" to sink into people's minds—especially official minds. It was in this, perhaps, that the M.I.D. showed its mettle, for both Major Colley and Sir Henry Norman did all they could to cause the weapon to be developed and used. Sir Henry Norman was particularly original and keen. Some time afterwards, with myself and Segrave, he started a company to manufacture scooters, and I still think of him entering the courtyard of the House of Commons on one of these little vehicles.

During the second world war I was again in the Army. I produced various oddities, such as a machine for releasing pigeons, which often died when parachuted into occupied territory, where they might lie for weeks before being discovered. My gadget released them automatically after two days. I produced a few odd explosives—one of them very odd, for it nearly blew up my colonel. There was also a wireless pack for Commandos, an oil-firing water bomb, an anti-tank torpedo, a sticky-bomb cover, a few sabotage devices and a secret signaller. In 1918 I had played with gas turbines, infra-red photography, oscillograph engine-indicators and (very suggestive, this) magnetically assisted radio valves; but nothing has ever equalled the thrill of the first guided missile.

For reward, I have some original documents, plenty of photographs and the old secret patents long released. It seems very, very long ago that I appeared before the old Committee of Awards, somewhere about 1919. I was thanked very carefully but told that, as an experimental officer first class, R.F.C., I was "only doing my duty," whereas if I had been (it was added) in the A.S.C. I would have been eligible for award. This was like water on a duck's back at the time, but what still rouses me to fury is to hear and read so often that the first guided missiles were German, American, Russian, Czechoslovakian, Italian or French. I think perhaps I have mentioned it before . . . but I would like to repeat it. *They were British.*

TWO MORE CANBERRA RECORDS

LAST week saw two new record long-distance flights set up to the credit of Canberras. On Thursday, September 25th, the first machine took off from Binbrook for Malta with A.V-M. D. M. Boyle, C.B., C.B.E., A.F.C., A.O.C. No. 1 Group, Bomber Command, at the controls. His navigators were F/O. R. B. Brownlow (his P.A.) and Sgt. T. Cramp. The outward flight took exactly 3 hr. Luqa being reached at 1200 hr B.S.T. By 1410 the aircraft was airborne again on the return flight to Binbrook, which was completed at 1715 B.S.T. The journey of 2,914 miles was made at an average speed of 485 m.p.h., the total flying time being 6 hr 5 min. It may be recalled, by comparison, that in November last year, two Sea Furies flew to Malta from Lee-on-Solent in 3 hr 11 min, averaging 414 m.p.h., the flight being some 135 miles shorter than that from Binbrook, Lincs.

On September 28th, a Canberra B.2, (bearing No. 12 Sqn. crest) flown by W/C. H. P. Connolly, D.F.C. and Bar, A.F.M. (O.C. Flying at Binbrook), and navigated by S/L. D. Clare, D.F.C. took Air Chief Marshal Sir Hugh P. Lloyd, K.C.B., K.B.E., M.C., D.F.C., A.O.C.-in-C. Bomber Command, from London Airport to Eastleigh, Nairobi. This flight was officially observed by the Royal Aero Club and, subject to confirmation by the F.A.I., will constitute a record of 9 hr 55 min 16.7 sec, which represents an average speed of 427.3 m.p.h.

The total distance is 4,479 miles, and the machine made one refuelling stop at Fayid in the Canal Zone. The first leg took 4 hr 22 min, the time of arrival being 4.27 a.m. G.M.T. After 58 minutes it took off again to land at Nairobi at 9.58 a.m., the total flying time being 8 hr 57 min. The machine is due to return today, October 3rd, after the A.O.C.-in-C. has completed his visits in connection with ceremonies to mark the completion of the photographic surveying of African territory for the Directorate of Colonial Survey by Lancasters of No. 82 Squadron. Sir Hugh Lloyd, who is 56, is due to retire from the R.A.F. next April.

AUSTRALIA LOOKS AHEAD

THE Australian Chief of the Air Staff, Sir Marshal Sir Donald Hardman, has announced that the Commonwealth Aeronautical Research Laboratory has designed a twin-jet, two-seater, supersonic, all-weather fighter with sharply swept wings, and has further stated that plans are going ahead for the construction of ten new airstrips for jet aircraft. Locations include Darwin, Townsville, Amberley, Perth and Williamtown.

For the next two to five years, he added, Australian squadrons would be equipped with the Sabre and Canberra, both of which types are being built in Australia. The first Sabre will be in the air by March and the first Canberra by January.

FROM ALL QUARTERS

The Royal Flight to Singapore

EIGHT members of the crews who served in the B.O.A.C. aircraft in which Her Majesty the Queen flew to East Africa last February were among the crews of the Argonaut in which the Duchess of Kent and her son, the Duke of Kent, journeyed to Singapore last week-end. One crew flew the aircraft to Colombo and the other took over at that point; Capt. E. Rotherham was in command on the first part of the journey, and Capt. W. N. C. Griffiths on the second.

The Argonaut, G-ALHK, took off from London Airport on Saturday morning and was routed *via* Rome, Nicosia (night-stop), Bahrein, Karachi and Colombo (night-stop). It arrived at Singapore at 0932 hr G.M.T. on Tuesday.

Meteors Busy in Korea

GLOSTER Meteors of No. 77 Squadron, R.A.A.F., lately destroyed ten enemy-occupied buildings north of the Korean battlefront and have been providing protective cover for Douglas B-26 Invaders.

On the same front North American Sabres of the U.S.A.F. are keeping up their excellent work, as witness their September score-board: 55 Mig-15s destroyed, six probably destroyed, and 51 damaged. In one night B-26s knocked out 70 lorries, cut eight roads and attacked troop and supply concentrations.

Mr. Churchill Congratulates Gliding Team

THE Minister of Civil Aviation, Mr. A. T. Lennox-Boyd, and Lady Patricia Lennox-Boyd held a reception on Thursday of last week, at their London home, for the British gliding team who competed in the World Gliding Championships in Madrid in July. Also present were distinguished guests from the world of aviation including several members of the Government and former Ministers of Civil Aviation.

Mr. Lennox-Boyd, in proposing a toast to the members of the team, read a message from the Prime Minister: "Pray congratulate on my behalf the British team who did so well in the International Gliding Championships—especially Philip Wills, who is now the world gliding champion, and also the Slingsby Sailplane Company on the success of their gliders.—Winston S. Churchill."

Away at Last

THE 40 airliners which for two and a half years have proved a bone of legal contention between the Chinese Communist Government and an American-owned company, Civil Air Transport, Inc., were being loaded into a ship at Hongkong under a strong police guard last Monday. Their destination was believed to be the Philippines.

C.A.T., who operated air routes in Nationalist China before the Communist occupation, claimed that the aircraft—DC-3s, Commandos and Convairs, valued at £1,000,000 sterling—were their property, as they had bought them from the Nationalists just before the Communists seized the mainland. The Hongkong Supreme Court ruled the claim to be unfounded, but on July 28th this year the Privy Council's Judicial Committee reversed the decision.

Off-shore Procurement

AFTER his visit to the S.B.A.C. Display, Mr. James J. Haggerty, Military Aviation Editor of *American Aviation*, had talks with officials of the Mutual Security Agency concerning the latest off-shore procurement plans. He reports that the Fokker company will build the Vickers-Supermarine Swift under licence, adding that Fokker has a production capacity for 700 aircraft between now and 1956. The Belgian Fabrique Nationale company, which has been building Derwents, will produce the Avons for the Fokker-built Swifts. In France, Marcel Dassault will build a new—Mk. 4—version of the M.D. 452 Mystère. This will have a different fuselage and a new wing and will be powered by an Atar 101D turbojet built by the SNECMA concern.

The Fiat company will build both the airframe and the Ghost turbojet for the de Havilland Venom, for which the designation Venom N.F.3 (possibly signifying the installation of an afterburner) is mentioned. Mr. Haggerty further reports that the Canberra is now out of the M.S.A. picture.

LAND, WATER, SNOW are the operating media of this Honningstad Finnmark 5A flying boat recently demonstrated at Fornebu, near Oslo. The ski/wheel undercarriage was designed and built by Dowty Equipment Ltd., and the makers of the aircraft inform us that this combined gear has no noticeable effect on the inherently good seaworthiness of the sponson-stabilized flying boat.

Fulmer Institute Ceremony

AT the Fulmer Research Institute on Tuesday last, Sir Archibald Rowlands, G.C.B., Permanent Secretary, M.o.S., unveiled a memorial plaque to the founder of the Institute, the late Col. W. C. Devereux, C.B.E. The occasion was an "open day" on which visitors were conducted round the laboratories.

John Cobb

IT was with shocked regret that we heard, last Monday, of the death of John Cobb, during an attack on the water speed record in his Ghost-engined boat *Crusader* on Loch Ness. According to Philip Mayne, the well-known timekeeper, the boat was going magnificently, and must have touched at least 215 m.p.h. Cobb completed the measured mile at 206.8 m.p.h., "but about 150 yards from the post," said Mr. Mayne, "his engine shut off momentarily. He opened up again just before he reached the end of the mile and was going full bore." When Mr. Mayne looked up from his stop-watch the boat had vanished, leaving only floating wreckage. Several other eye-witnesses said that it had bounced and dived after striking three large ripples.

Many people in aviation got to know Cobb—and like him well—when he was an A.T.A. ferry pilot. For a time he was in the R.A.F. (those who saw the film *Target for Tonight* may remember recognizing him in the control-room scene) but, becoming discontented with ground duties, he applied to re-join the A.T.A. During the last two years of the war he was flying almost every day on a wide variety of aircraft. One who served with him states: "He was the finest type of Englishman: self-effacing, extremely modest, completely imperturbable—a kindly man."

John Cobb, who was 52 years of age, was educated at Eton and Cambridge. Before the war he held the Brooklands lap record at 143 m.p.h. and in 1947 he raised the world's land speed record to 394.2 m.p.h. at Salt Flats, Utah; he was the first man ever to travel at over 400 m.p.h. on land.

Deep sympathy will be extended to his widow by his many friends in the motoring, marine and aviation worlds.

Farnborough Accident—Compensation

AN official statement regarding compensation to victims of the accident to the D.H.110 at the Farnborough Display has been issued on behalf of the Society of British Aircraft Constructors, Ltd., The de Havilland Aircraft Co., Ltd., and the insurers of that company:—

> "In connection with the unfortunate accident which occurred in the course of the air display at Farnborough on September 6th, legal opinion has been expressed that the victims have no remedy at law against any of the parties concerned. This position has been carefully considered by the Society of British Aircraft Constructors, the de Havilland Aircraft Company, and the insurers of that company, and they feel that, irrespective of legal liability, compensation ought to be paid to those who have suffered hardship, and arrangements are being made for this to be done."

From this it seems that legal opinion, which might still be contested in the Courts, has indicated that there is no case of legal liability for compensation; but, in view of the moral obligation recognized by the interests named, the Society, the company and particularly the insurers of the company are going to stand together and contribute towards the compensation which they will decide to pay.

According to the Civil Aviation Act, the owners of an aircraft are responsible for damages resulting from such an accident, but it is the practice to exempt the Crown. It seems likely that, as is usually the case with military prototypes, the D.H.110 was Government property hired to the de Havilland Company for the week of the Display.

HERE AND THERE

FORETASTE: Given suitable weather, Comet passengers on the B.O.A.C. London-Tokyo service, scheduled to begin next spring, will have this magnificent view of the coastal suburbs of the Japanese capital. The photograph was secured from about 30,000ft in G-ALYP during its recent proving flight. Japan Air Lines, incidentally, have ordered two Series II Comets.

Sweden Buys Venoms

THE Swedish Government has placed an order with de Havillands for a number of Venom night fighters. They will be powered with Ghosts built under licence by the Svenska Flygmotor company of Stockholm.

Cyprus Extension

COMPULSORY acquisition of 2½ square miles of land adjoining Tymbou airfield, Cyprus, which is to be enlarged by the R.A.F., was recently announced; it is intended to extend the main runway to a length of 1¾ miles. At present Tymbou is used only as an alternative landing-ground to Nicosia airfield.

The New Zealand Race

THE Australian Minister for Air, Mr. William McMahon, has confirmed that the R.A.A.F. is to enter an Australian-built Mosquito for the England-Christchurch (New Zealand) Air Race next October. Although entries close on January 31st, there is still no other news of definite nominations; this does not imply that the event is likely to be poorly supported, but merely that—as in many less important air races—most prospective entrants are leaving it until the last possible moment. Nor has any decision been reached as to which British airfield will be the starting-point. The R.Ae.C. informs us that the choice will be made after January 31st, when the number and nature of the entries has been examined.

Reunion Visit

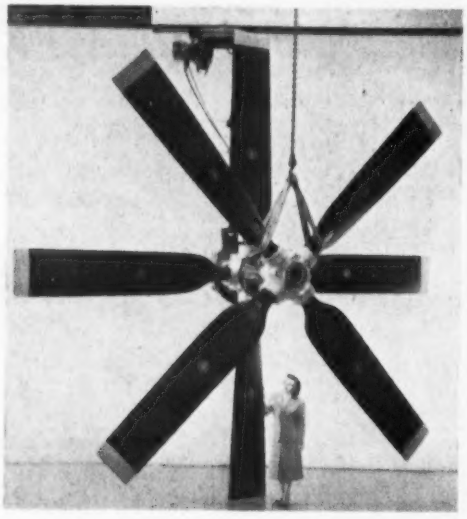
NOW spending some weeks in this country in order to visit his friends in the industry is Mr. L. C. Williams, engineering manager of the Fairey Aviation Co. of Australasia Pty., Ltd. He is staying at the Royal Aero Club.

Pilotless Bombers

IT is barely a month since preliminary details of the Hughes XF-98 Falcon and the Boeing XF-99 Bowmark were released. Both are pilotless intercepters for the U.S.A.F. Now comes the first release on the Northrop XB-62 Snark and the Bell XB-63 Rascal, which are pilotless bombers for the same Service. The Northrop Snark is a long-range surface-to-surface missile, whereas the Bell Rascal is air-launched. They are not the first U.S.A.F. remote-controlled bombers; this historic place is filled by the Martin B-61 Matador.

Developments at Wood Ridge

AMERICAN turboprop development appears to be proceeding slowly but surely. Curtiss-Wright flew a 5,500 h.p. unit called the T-35 Typhoon in the nose of a B-17 in 1947, since when nothing has been heard of it. Now, however, comes news of a new turboprop from the Wright corporation which will "dwarf in power any aircraft engine yet made public." It is worth recalling that the Armstrong Siddeley Sapphire (as the J-65) is entering production by Wright. Ever since the Sapphire first went to America, rumours of a turboprop version have been current; one report mentions such a unit for new versions of the B-36, B-47, and B-57 Canberra. The mass flow of the Sapphire is such as to produce at least 8,000 s.h.p., and probably nearer 10,000. But Curtiss-Wright's Propeller Division has developed a new series of "Turbolectric" airscrews capable of absorbing powers of up to 20,000 h.p., which is far in advance of any previous aircraft practice. One of the range is illustrated on this page.



OCTOPROP: One of the most impressive airscrews ever made, this 18ft diameter unit (see accompanying paragraph) is designed for use with turboprops of 15,000 h.p. It is a Curtiss-Wright hollow-steel-extrusion development.

Over the Top

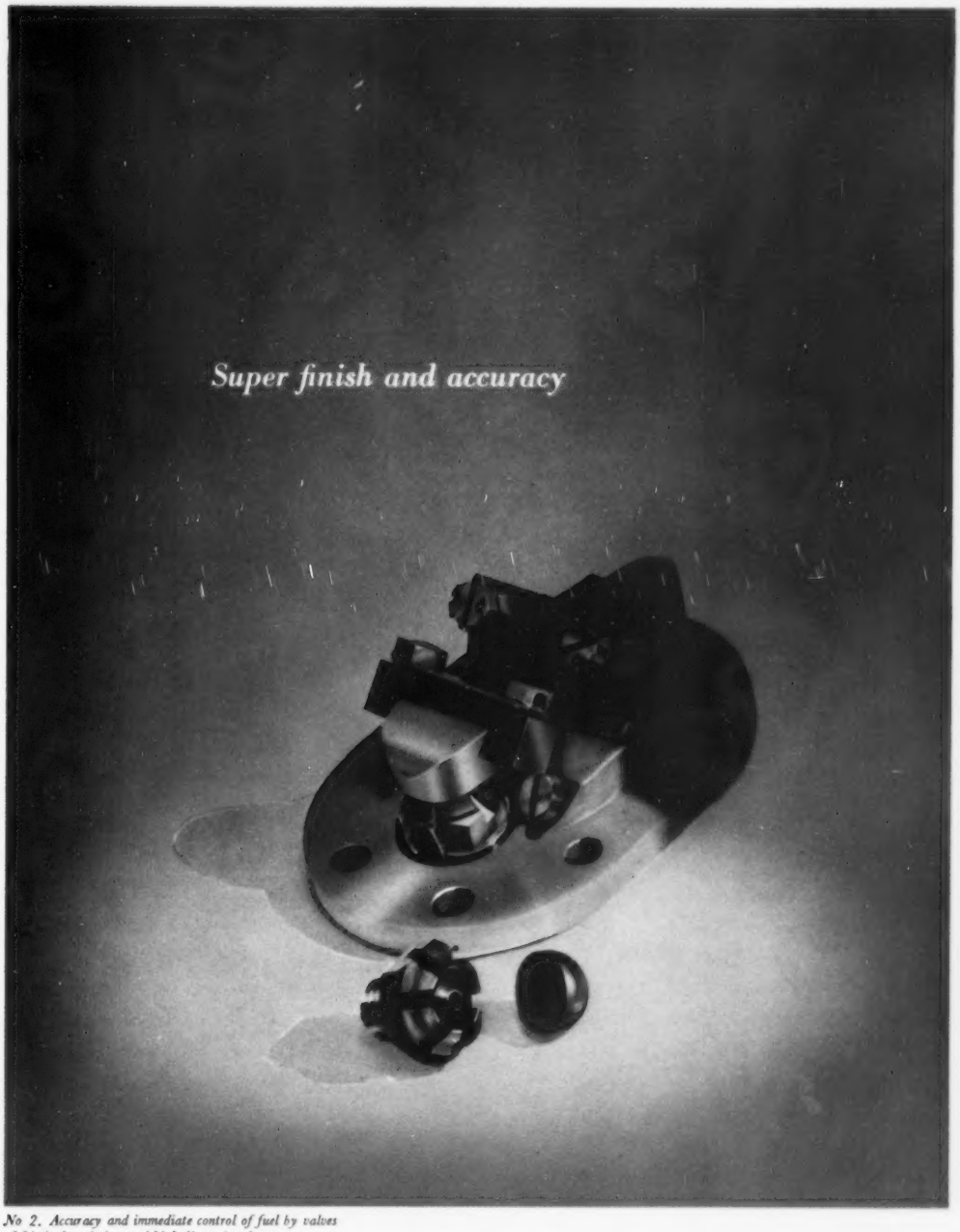
THE R.A.F. "navigational test-bed" Lincoln, *Aries*, accomplished a flight over the North Pole during its recent Arctic journey. Announcing the fact, the Air Ministry says that engine trouble developed between Manby and Keflavik, where the aircraft landed, and again after passing over the North Pole; this necessitated a landing at Thule, Greenland, where much help was received from the U.S.A.A.F. After an engine change it was decided to return to Manby and not to continue to Whitehorse Airport in Canada.

Records Confirmed

THE Canberra transatlantic flights on August 26th have now been confirmed by the F.A.I. as two point-to-point records. The speeds were: Gander-Belfast, 974.503 km/hr (605.52 m.p.h.); Belfast-Gander-Belfast, 663.038 km/hr (411.99 m.p.h.). The crew were W/C. R. P. Beamont (pilot), F/L. P. Hillwood (second pilot) and S/L. D. A. Watson (navigator). Also recently confirmed by the F.A.I. are four more of the point-to-point records gained by T. W. Hayhow in his Auster Aiglet; he now has 27 officially confirmed light aeroplane records to his credit.

Seen at Luton

NOTICED at the Luton Airport control-tower inauguration (reported on page 459) was a Percival Provost—the first so modified—with throttle, pitch and certain other controls on a central pedestal. Previously, separate throttles have been provided on opposite sides of the cockpit, but it seems that some Service pilots do not fly so well with their left hands. Thus port and central levers are to be fitted in the side-by-side cockpit from now on. Another point of interest concerned the D.H. Comet which gave a brief demonstration: it was carrying a spray-ring supported from the fuselage and positioned in front of the starboard inner Ghost; extended icing trials are understood to be in progress.



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HERE AND THERE . . .

The Russians in Germany

IT is learned from Germany that the Russians have moved all operational squadrons away from the Berlin area; only training units, equipped with Pe-2s, Tu-2s, Po-2s and Yak-14s, remain. Centres of operational activity are now Finow and Rechlin-Laerz. The airfield at Gaarz, near Peenemunde, is deserted.

Helicopter's 1,234 Miles Non-stop

A HELICOPTER distance-flight which, if approved by the F.A.I. as a world record, will easily beat any previous such achievement, was made on September 17th by Elton J. Smith, a Bell Aircraft test pilot, in a Bell 47 D-1. With 187 gallons of fuel at take-off, he flew 1,234 miles non-stop from Forth, Texas, to Niagara Falls Airport, taking 12 hr 57 min for the journey, representing a speed of about 95 m.p.h. This exceeds the existing helicopter distance record (Maj. F. T. Cashman, Sikorsky R.5A, 704.5 miles, in May 1946) by over 500 miles; it also easily beats the 947-mile hop made by the Sikorsky H-19s which crossed the Atlantic last August.

L.A.P. and Local Residents

FOUR Middlesex local authorities—those of Heston, Isleworth, Hayes and Harlington—met last week to discuss the formation of a joint committee to deal with problems arising from the operation of London Airport *vis-à-vis* local residents. Chief among these questions is that of noise; an association representing people living in the area is now campaigning for an Act of Parliament "which would give the private citizen the right to compensation for loss of amenities where an airport has been developed in close proximity to an old and well-established residential area." They also seek to include a clause establishing a maximum permissible sound-level, "at any rate for aircraft taxying or being ground-tested."

VARIED TYPES—including an R.C.A.F. Lancaster, U.S.A.F. F-80 and two C-54s and a Norseman—seen in a snow-clad setting on Whitehorse Airport, lying at the junction of the Alaska Highway, River Yukon and the railway to the Pacific Coast. A minor airfield before 1939, Whitehorse was greatly extended during the war. It now has a 7,200-ft main runway and handles an increasing amount of airline traffic (C.P.A., P.A.A., Northwest, and "bush" operators).

IN BRIEF

A NEW edition of *The Nimonic Alloys* has been published by Henry Wiggin and Co., Ltd., of Birmingham. Main additions to this general handbook are short notes on Nimonic 95, DS and DT alloys, and further long-period creep characteristics for Nimonic 80A.

* * *

The British Aluminium Co., Ltd., has opened a Southampton branch office, to handle sales of unwrought and fabricated aluminium and aluminium alloy in Sussex and Hampshire. Mr. W. H. Marston has been appointed area representative, and the new branch is at 20 Brunswick Place, Southampton (telephone: 76780; telegrams: Britalumin, Southampton).

The many types of rubber solutions and other adhesive compounds—including the new synthetic-rubber-based "Titebond"—produced by Surridge's Patents, Ltd., of Croydon Road, Elmers End, Beckenham, are listed in the fourth edition of the firm's brochure, *Industrial Adhesives*.

* * *

A booklet showing the various types of gears produced by Beard and Fitch, Ltd., gearing specialists, of 60 Britton Street, Clerkenwell Road, London, E.C.1, has recently been published. The firm has manufactured a number of gears for the Saunders-Roe Princess.

* * *

Non-destructive Methods for the Examination of Welds is the title of a memorandum recently published at 5s by the British Welding Research Association, 29 Park Crescent, London, W.1. It forms an introduction for readers requiring to know the merits of the various methods.

* * *

A new floor-type saw bench, with an 8in-diameter saw and 2⅜in depth of cut, has been produced by the Startrite Engineering Co., Ltd., of Gads Hill, Gillingham, Kent. The height from floor to table is 37in, table size is 17½in by 23in, and power is provided by a ½ h.p. motor.

* * *

Mr. G. A. T. Burdett, A.M.I.I.A., M.I.A.M.A., has been appointed publicity manager to Holophane Ltd., scientific illuminating engineers, of London, S.W.1. A serving officer in the R.A.F.V.R. (Air Traffic Control), he was formerly with an agency handling English Electric technical publicity, and before that was for some time P.R.O. to the Plessey Company.

* * *

Conveyancer Fork Trucks, Ltd., announce the departure of Mr. G. E. Montague for Australia, to assist in the formation of an associate company, Conveyancer Fork Trucks (Australia) Pty., Ltd. The resident directors there will be Mr. J. N. Kirby, Mr. W. Gwinnett and Mr. Montague. Until recently Mr. Montague was London sales manager of Rubery, Owen and Co., Ltd.; he is succeeded in that position by Mr. A. G. Burgess.

ALL-ROCKET is the armament of these North American F-86D Sabres, radar-equipped and having an afterburning installation. It will be noted that there is no dihedral on the tailplane, as on the F-86E, now familiar in England as well as in America and Korea.

THOSE SUPERSONIC BANGS

Two Possible Explanations Examined

By A. H. YATES*

MANY visitors to the S.B.A.C. Flying Display heard, for the first time, the double bang from the sky associated with supersonic dives—in this instance from the Hawker Hunter and the de Havilland D.H. 110. Speculation about the origin of the sounds has been widespread, and two explanations are discussed in this article. A satisfactory solution must account for more than one bang and must show why the time-interval between the bangs is less than one second, but not so short that they cannot be heard separately. In this article two alternative explanations are put forward.

First of all we must understand the nature of a "bang"—any bang—in relation to a steady noise-level. An aircraft is a source of sound energy, and when the velocity of the machine relative to the ear is constant the rate at which sound-energy reaches the ear decides the steady noise-level. The noise is loud when the amount of energy received is large—either due to a large emission or to the short distance of the source from the ear. A bang is a temporary increase in noise-level over a very brief period; and the characteristic of an explosion, or of a bang, is the high rate of change in the noise-level. The more sudden the rise in level, the more staccato is the explosion.

At many flying displays in recent years aircraft have been flown towards the spectators at speeds approaching that of sound. In such circumstances the noise emitted by the aircraft during its approach arrives first, thus giving some warning of the approach, but the sudden rise in noise-level as the aircraft passes tends to become an explosion as the speed of the aircraft approaches that of sound. If an aeroplane could be flown just above the runway at exactly the speed of sound (i.e., at Mach 1) no sound would be received during the approach; but as the machine passed by, the whole of the sound emitted during the approach in the direction of flight would be received in one staccato packet. The ear would undoubtedly record an explosion.

If the flight just above the runway were made faster still, i.e., at supersonic speed, there would again be no audible warning of approach. But as the aircraft passed, the sound emitted most recently would be heard first, followed by the noise emitted earlier and "left behind" by the machine. The sudden rise in noise-level would again be explosive, but it would not have the same energy-content as that delivered by the "Mach 1" aircraft, the whole sound of which arrived at the same instant.

Let us now consider the noise emitted during a vertical dive towards us from, say, 45,000 to 15,000ft by an aircraft which starts at subsonic speed, becomes supersonic for a few thousand feet and then slows again below the speed of sound. When the Mach number, M, is less than unity, sound leaves the aeroplane and moves in all directions, including that towards our ears, at the speed of sound. As the aeroplane reaches M = 1 the noise emitted for a few moments travels with it, but at supersonic speeds is left behind. At M = 1.05, for example, the aircraft is leaving its noise behind at about 35 m.p.h.; but as soon as the speed again becomes subsonic the noise overtakes the machine and carries on toward the ground.

All the noise emitted during the dive in our direction reaches our ears eventually, but not at a uniform rate. To find out exactly what the ear receives it is first necessary to calculate at what height the aircraft is at various times after the dive is begun and then to add on the time taken for the sound emitted at this height to reach the ear. When this is done it is found that the first sound received from the diving aircraft is from around the height at which the dive slows to subsonic speeds. The rate at which the sound is received is very large, and produces a bang. Immediately afterwards the sound emitted during the supersonic period follows, arriving at the same time as that emitted at lower altitudes. Then follows a bang produced when the aircraft first became supersonic. This energy, emitted at great altitude and left behind by the diving aircraft, arrives a fraction of a second behind the first bang.

Each time the component of the speed of the aircraft towards the ear passes through the speed of sound at the height concerned, a bang is produced. Usually there will be two, but there may be four if supersonic speed is reached twice in the dive.

More of the characteristics of the dive can be made clear if a numerical example is considered. Let us consider the history of the noise reaching the ground during three supersonic dives. In Fig. 1 are shown three assumed variations of Mach number with height. The aircraft is assumed to dive vertically towards us, reaching sonic speed at 36,000ft and to accelerate to M = 1.05. In dive No. 1 the speed again becomes subsonic at 15,000ft; in dive No. 2 the flight is supersonic only down to 25,000ft; and in dive No. 3 the machine reaches M = 1.02 between 36,000ft and 30,000ft, but slows to M = 0.96 at 26,000ft. It again flies supersonically from 23,000ft to 15,000ft, this time reaching M = 1.05.

Time is measured from the instant the aircraft dives past 40,000ft, and the time at which the sound emitted at height X ft reaches the ground is given by

$$t = \int_{X}^{40{,}000} \frac{dx}{V} + \int_{0}^{X} \frac{dx}{a}$$

where V is the diving speed and a is the speed of sound. Since both are functions of height X, the integrations have been made graphically with the results shown in Fig. 2. The sound emanating from various heights all reaches the ground within a short period about 38 sec after the dive begins. The noise-level depends on the rate at which sound is being received and it will be noticed that the rate is twice theoretically infinite: in dive No. 1, for example, the sound from around 36,000ft and from around 15,000ft arrives in two bangs separated by two-thirds of a second.

In this instance it is remarkable that, though the aircraft is supersonic for about 20 sec, the bangs marking the ends of this

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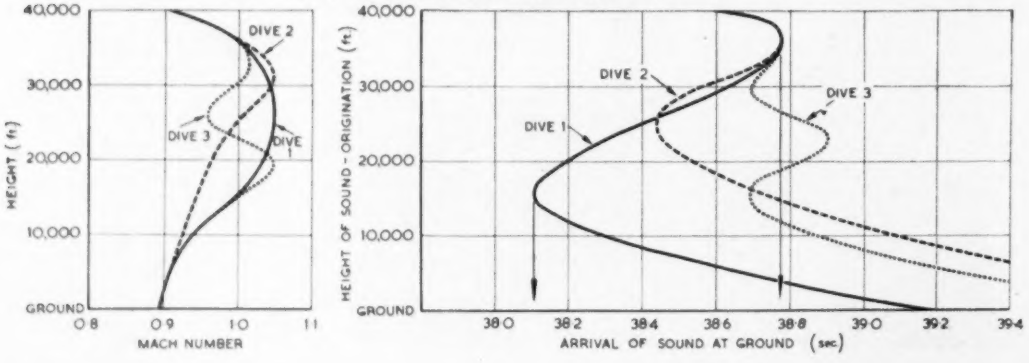
[*The author is a senior lecturer in the Department of Aerodynamics at the College of Aeronautics, Cranfield—Ed.]

Fig. 1 (left): Assumed variation in Mach number during three vertical dives. Fig. 2 (right): Time-histories of noise heard at the ground. When a curve becomes vertical the noise reaches a peak—i.e., a "bang."



period arrive within a second of one another. The calculations for dive No. 2, in which the supersonic period is shorter, show that the bangs are now separated by only one-fifth of a second. The assumption in dive No. 3 of four passages through the "sonic barrier" yields four bangs, two of which arrive together. Thus, if an aircraft's speed twice became supersonic, the ear would record three or four bangs in rapid succession. It will be realized that if the aircraft speed in the direction of the listener's ear just reaches the speed of sound (M = 1), there will be but one bang.

The examples taken are of vertical dives towards the observer. The sounds heard by listeners not in the line of flight will be rather different. As the distance from the line of flight increases, the period over which the aircraft approaches supersonically diminishes, with the result that the bangs arrive more closely together. Outside the ground-area over which one bang is heard there will be no sudden change in the noise-level, since the approach is never supersonic. The angle of the cone within which the bangs are heard increases with the supersonic Mach number, so that, as speeds increase, the ground-area over which these noises are heard will become large even if the flight-path is more nearly horizontal.

What assumptions have been made in the course of this explanation? The aircraft has been treated as a point-source of sound, radiating noise energy at a constant rate. If the noise energy travels at the speed of sound, we have shown that the *rate* at which it is received by the ear is not uniform but rises to peak values which are associated with the aircraft passing M = 1. It has been asserted that these large rates of reception of sound energy will be described by our brains as "bangs." It has not been necessary to introduce the concept of a shock-wave, although that is, in fact, what reaches the ear. Neither have we mentioned the diminution of sound as distance from the source increases nor the frequency of the noise, although any prediction of the character of the bang (staccato or dull, low or high pitch) must include these factors. In the absence of any published facts about the quality of the noise, it seems unprofitable to allow for them at present.

Now let us consider the alternative explanation to which reference was made in the introduction. When a body is moving supersonically no sound or other pressure disturbance which is emitted travels ahead; it remains concentrated in a shock-wave which travels along with the body. There are several of these shock-waves associated with an aircraft (from the wings, fuselage and tailplane, for example) and, when the diving speed falls below the speed of sound, these waves—like any other small pressure-disturbance—travel on at about sonic speed until they are dissipated or reach the ground. It is probable that a shock-wave passing the ear sounds like a bang, and it has been argued that the bangs heard at Farnborough were caused by the arrival of the shock waves at the ground. But why *two* bangs?

The distance between any pair of shock-waves during the supersonic dive cannot be greater than the aircraft length—say, 50ft—and if these waves continue to the ground at the speed of sound then they will reach the ear only 50/1,100ths (i.e., about one-twentieth) of a second apart. In this period several other shock-waves from other parts of the aircraft would be expected to arrive; and, further, the period of one-twentieth of a second is shorter than the intervals between the bangs heard at Farnborough.

Hawker Hunter—first British, sonic single-seat fighter.

Now it may be that the problem has been over-simplified here. Firstly, at a shock-wave there is a finite pressure-change while at a sound-wave the changes are minute. The speed of propagation of sound is known, and it is also known that shock-waves travel through the air rather faster. Secondly, studies of the dissipation of a group of shock-waves such as is emitted by an aircraft show that they tend to collect together in two concentrated shocks and that the leading one travels faster than the second. A rough calculation by Professor G. N. Ward has shown that, after about 600 aircraft-lengths (i.e., 30,000ft) the waves would increase their distance apart five times and strike the ear as two bangs about one-quarter of a second apart—which is about the right interval. If this explanation is accepted, it appears that the noises leave the aircraft as it reduces speed through M = 1, and that any disturbance emitted on accelerating through M = 1 higher up either makes no bang or wastes away during the descent.

The only satisfactory way of deciding which explanation is true (if, indeed, either is true) is to correlate the properties of the sound received (interval, number of bangs, area of reception, etc.) with details from the pilot of the heights at which M = 1 was passed. Only the research workers of the Ministry of Supply and the aircraft manufacturers are in a position to do this.

SAFETY EXPERT'S APPOINTMENT

FROM Elliot Equipment, Ltd., the South Wales specialists in dinghies, parachutes and other safety-equipment, comes the announcement that Lt. Cdr. G. W. R. Nicholl, R.N. (lately O.C. the Safety Equipment and Survival Training School), has joined their staff to carry out technical liaison work.

Lt. Cdr. Nicholl

Lt. Cdr. Nicholl has had a distinguished career in the Royal Navy, which he joined as a boy in 1923. His appointments during the past ten years have included those of C.O. Advance Amphibious Aircraft Training Flight; C.O. No. 700 Squadron (on appointment which entailed a post on the staff of the C-in-C. Home Fleet); liaison officer in the American carrier U.S.S. *Ranger;* Staff Officer (Air) to Admiral Sir Arthur Power in H.M.S. *Renown;* Fleet Aviation Officer on Admiral Power's (C-in-C. East Indies) staff; and head of the Aircraft Accident Prevention Section, Admiralty. In addition to holding the appointment mentioned in the opening paragraph, he has been technical adviser to the Royal Naval Lifesaving Committee.

Elliot Equipment, Ltd., is a subsidiary of P. B. Cow and Co., Ltd., and Lt. Cdr. Nicholl will be available to any customers of the Group who may require his advice.

CANADA'S ALUMINIUM OUTPUT

PRODUCTION of aluminium in Canada in 1951 was 444,741 tons, a peacetime record and 90 per cent of the maximum wartime output achieved in 1943. Important developments are under way. At Kitimat, in British Columbia, the Aluminium Co. of Canada, Ltd., is building a works which will have an ultimate output of 500,000 tons annually. First production is scheduled for early 1954 at the initial rate of 91,000 tons per year. In the province of Quebec, a new reduction works at Isle Maligne with an annual capacity of 50,000 short tons is nearing completion, and two hydro-electric power sites on the Peribonka River are being developed to supply it.

INSTRUMENT SPECIALIST'S POST

IT is announced that W/C. E. G. Monk, A.F.R.Ae.S., has been appointed technical sales manager of the aviation division of Elliott Brothers (London), Ltd. the instrument manufacturers.

W/C. Monk joined the Royal Air Force as an apprentice in 1922 and learned to fly in 1927. After service as a bomber, fighter, and torpedo-attack pilot, he qualified as a flying instructor and spent three years at the Royal Air Force College in this capacity.

He specialized in autopilots and formed the first R.A.F. Instrument Repairers' School, in 1938. He subsequently spent five years in technical posts in the Air Ministry and Ministry of Aircraft Production, acting as Service liaison officer for the Director of Instrument Research and Development for over three years.

W/C. Monk retired from the R.A.F. in 1945 in order to become the liaison engineer of Sangamo Weston, Ltd.

AIRWORTHINESS in OPERATION

Mr. R. E. Hardingham's Commonwealth Lecture before the Royal Aeronautical Society

THE Eighth British Commonwealth and Empire Lecture was due to be read before the Royal Aeronautical Society yesterday, Oct. 2nd, by Mr. R. E. Hardingham, O.B.E., F.R.Ae.S., M.S.L.A.E., secretary and chief executive to the British Air Registration Board. His notable paper, the full title of which was "Maintaining Airworthiness in Operation," is given—in slightly condensed form—below. The lecture was very fully illustrated; the most important diagrams are reproduced in our summary.

Mr. Hardingham's introduction to the paper pointed out that it dealt primarily with a broad explanation of arrangements in the U.K. for maintaining the airworthiness of civil aircraft in transport operation. Because the problem of the ever-increasing complexity of modern aircraft was very much to the fore at present, an attempt was also made in the paper to show how this had affected the task of the operator, the pilot, the engineer and the airworthiness authority. Many qualities were demanded of the modern aeroplane: the ability to fly fast, to carry large loads in all climates and weather conditions, and by day or by night; and this had to be done with safety, regularity, and comfort.

Faced with using the highly complicated aeroplane, the operator had to provide superlatively trained personnel for flying and maintenance duties. Fortunately, since the war British operators had taken a most responsible attitude in their domestic rules and operations planning. The airworthiness authorities of the world had tried to keep pace with events, and procedures were constantly modified. In Great Britain the principal trends had been:—

(a) The elimination of unnecessary margins, with the consequence that safety requirements were now tailor-made to fit more closely particular types of flying in particular circumstances.

(b) The provision of much more data to assist the crew and operators to judge the suitability of the aeroplane for the flight.

(c) Extension of test procedures and maintenance methods to deal with the complex systems.

Mr. Hardingham commenced his paper proper under the heading of "Suitability." Of "initial certification" he said that acceptance of a satisfactory standard of airworthiness was indicated when a prototype was granted an unrestricted C. of A. This did not necessarily imply that the published requirements of the airworthiness authority had been complied with in every detail, but it did mean that the authority was satisfied that where variations had been required or accepted the basic aim of the requirements had been achieved or improved upon. In accepting a prototype there were many features, such as workmanship and good engineering practices, which had received due attention though they were not covered by written requirements.

The responsibility of the authority did not end here, for it was necessary to ensure that all steps had been taken to enable a level of safety implicit in the initial certification to be maintained in day-to-day operations. The old concept of basic airworthiness unrelated to operating circumstances was fast disappearing. Suitability for the conditions prevailing was now an important consideration.

The issue of a modern C. of A. was contingent on the existence of a Flight Manual and a service and instruction manual—the first to judge the suitability of the aircraft to the circumstances of its use, the second to maintain its airworthiness. A certificate without this supporting data would be valueless nowadays.

Under the heading "Day-to-day Safety," the lecturer said that the immediate task was to provide suitable information relating to the performance of the aeroplane and the conditions under which it might safely be operated, and to see that the information was properly used and that any laws enforcing its use were complied with. Because day-to-day variations in the state of an aircraft would occur, it was not always possible to match exactly its qualities to its immediate intended use. Hence the standard required for initial certification was found to be a little higher than that which could be expected for the least-safe individual operations.

This led the lecturer to explain the use and contents of the Flight Manual. It was a document that had legal status because of its official association with the Certificate of Airworthiness, and each individual aircraft had its individual Manual. Phraseology needed to be specific and unambiguous. The Manual contained a brief description of the aeroplane and a statement as to whether it complied with the requirements in respect of flight by night, at high altitudes, or in icing conditions, and there was a section headed "limitations"—speed, power-plant weight, normal and emergency procedures, and so on. Sections dealing with handling and performance followed.

The writing of the airworthiness performance standards and the production of the Manual were the responsibility of the A.R.B. Operational standards which defined minimum margins for take-off and landing distances and obstacle clearance *en route* were laid down by the M.C.A. through the medium of Air Navigation regulations. The airworthiness and operational standards were complementary and enabled a certain minimum performance to be enforced for public transport operations.

The section of the Flight Manual which included performance was an indication of the outstanding trend in civil airworthiness requirements, namely, the replacement of arbitrary minimum values by a stipulation that the aeroplane's characteristics and performance had to be determined and scheduled. This resulted in a reduction in airworthiness margins. A close operational control had to come in their place.

Before the Second World War most aeroplanes had had lower wing-loadings and hence shorter distances to take off and land. Lower speeds, and the general practice of flying in visual contact with the ground, had made forced landings, by day at least, a passably safe procedure. Long oceanic flights had not then been routine operations, and the commonly accepted standard of safety had also been lower. For these reasons it had been necessary only to consider an aeroplane's performance with all its engines operating.

War-time developments had led to a generation of aeroplanes in which the demand for speed and range had resulted in high wing loadings and high take-off and landing speeds with poor prospects of safe forced landings. Unfortunately, engine-failure rates had not decreased, and personal judgment would no longer suffice. It was not fair to the pilot or sound practice for the operator to allow the take-off weight of a modern transport to be assessed in the old-fashioned way.

To meet the conflicting demands of safety and load-carrying capacity had led inevitably to a close matching of the performance of the aircraft to the circumstances of its use, the objectives being the establishment of a minimum level of safety for all air-transport operations which would be world-wide in application and uniform in effect whatever the climatic and geographical conditions. The operator was asked to adjust the weight of an aeroplane so that a minimum performance was achieved in relation to each flight.

The new airworthiness performance-standards, by requiring certain performance minima with all engines operating or an engine inoperative, established the maximum permissible weights within the limits of the structural strength for varying altitudes and temperatures. The performance data, together with corrections for operational variables, were incorporated in the Flight Manual—which was a part of the C. of A.

The lecturer then turned to the use of the performance data in the Flight Manual. "The actual calculation is more complicated to describe than it is to do," he said. "It is rather like filling in an income-tax return. A little practice soon shows how to do so for a particular case, but a general description is inevitably cumbersome."

The nature and object of the calculations could, however, be described. The first step was to find the maximum weights permissible for take-off and landing assuming in the first instance that there were no limitations for runway length, obstacle clearance, and so on. The second step was to relate the performance more closely to the proposed route, considering take-off, landing from a height of 50ft, clearance on *en route* obstacles. In this connection the actual figures quoted in modern British Flight Manuals were less than the performance which would normally be obtained. This difference for larger aircraft was associated with the fact that the Flight Manual performance assumed one engine to have failed. In addition, the performance was reduced to allow for other contingencies so that the scheduled values were in the nature of guaranteed ones.

In connection with *en route* performance, Mr. Hardingham illustrated a simple case of the so-called downhill procedure (Fig. 1). If the aeroplane is flying at height D_1C_1 and engine failure occurs at or after point D_1 it can safely clear the minimum safe altitude at D_2. If the failure occurs before C_1 the aeroplane can return to base, safely clearing point C_2. A reasonable overlap period D_1C_1, during which the pilot can decide whether to go on or return, is necessary in order to allow for possible navigational errors, and so on. Thus the flight-plan is drawn up on the

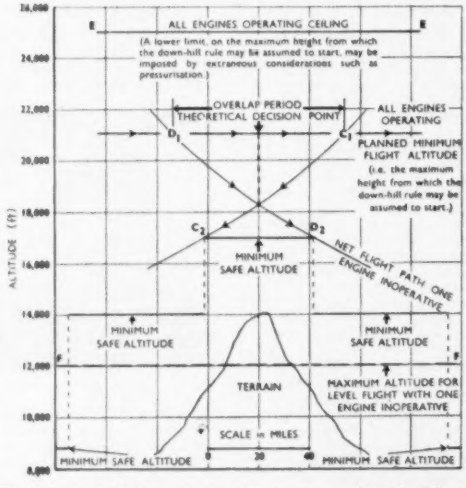
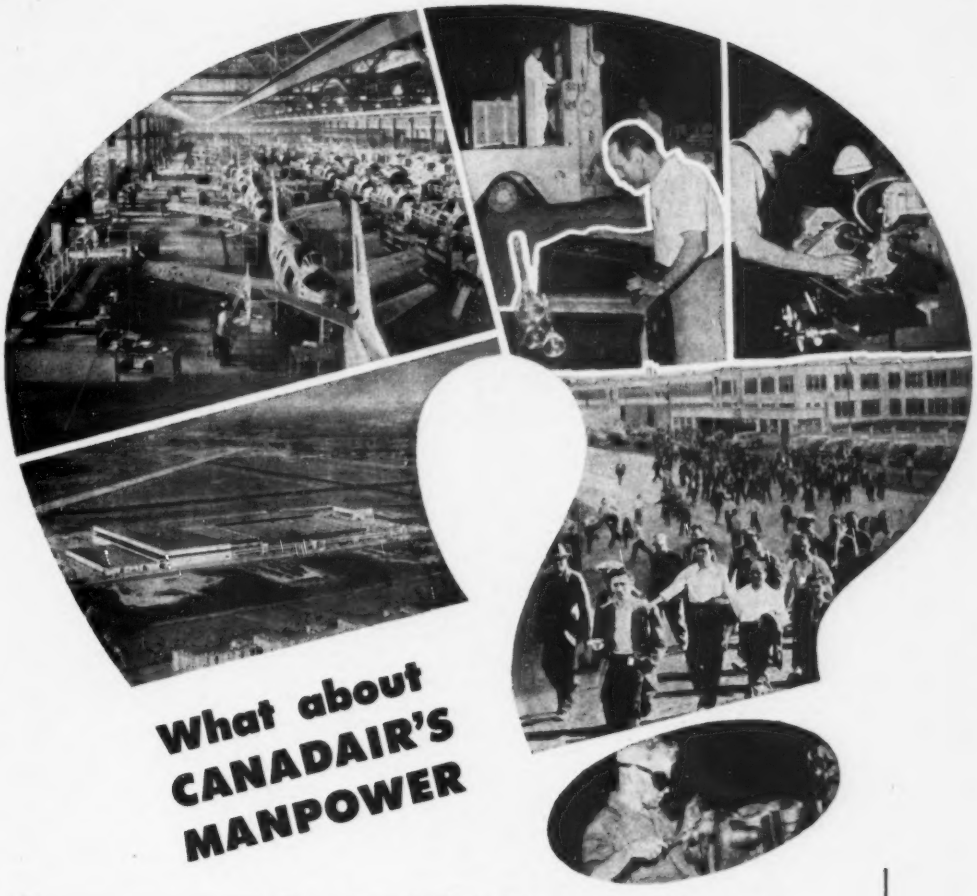


Fig. 1. En route performance calculations—an example of the "down-hill" procedure explained by the lecturer.



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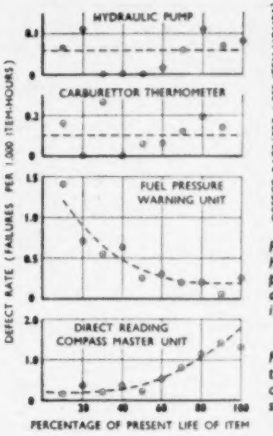

HYDRAULIC PUMP
CARBURETTOR THERMOMETER
FUEL PRESSURE WARNING UNIT
DIRECT READING COMPASS MASTER UNIT
DEFECT RATE (FAILURES PER 1,000 ITEM-HOURS)
PERCENTAGE OF PRESENT LIFE OF ITEM

Fig. 2 (left). Defect-rates (defects per thousand item-hours) remain fairly constant over the life of the item. In some cases a gentle rise occurs; in others, the item improves with age.

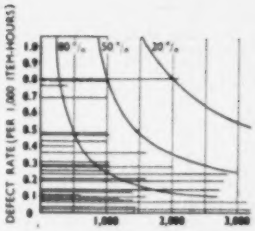


Fig. 3. If the defect-rate of an item is high, the proportion reaching the life at present fixed is low. Horizontal lines are present permitted lives of typical items; curves show percentages reaching the permitted life.

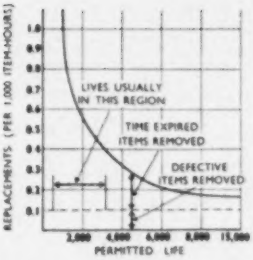
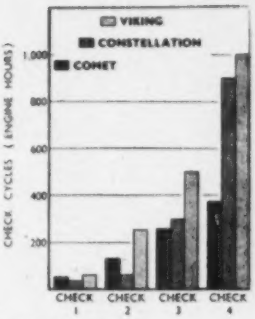


Fig. 4 (above). Effect of increasing life on the amount of work done provided the defect rate remains constant. Fig. 5 (right) Engine-check cycles of three well-known civil aircraft: the Comet, Constellation and Viking.



AIRWORTHINESS IN OPERATION . . .

basis that with all engines operating the aeroplane must be able to reach point D_1 before crossing the obstacle. There is no objection to flying above this level, although some other consideration places a top limit to the line EE. Having explained the drawing, the lecturer said that each of the calculations led to a figure for maximum weight at take-off, and the lowest figure was the safe weight for the operation.

Dealing with what he termed the flight-crew problem, Mr. Hardingham said that even a casual glance through a modern Manual showed immediately the fruits of the complexity to which he had referred earlier. In a recent Manual, for example, it was necessary to include more than three closely printed pages to tell the crew of the sequence in which fuel should be used. In the narrow sense this was necessary in order that strength and other conditions should be met, but in the wider sense was it right or proper that safe air transport should depend on such an exact prescription of human actions?

Turning in the second part of his paper to questions of serviceability and maintenance, the lecturer said that in describing the efforts of those concerned with ensuring that assumptions made in the certification of a prototype remained valid throughout the life of all aeroplanes of the type, it was necessary to examine past history. Since 1919, the maintenance of transport aircraft had been the responsibility of the licensed aircraft engineer, formerly known as the ground engineer. For years the method entailed periodic inspections in accordance with the knowledge and experience of the particular engineer, supported by a number of instructions from the constructor. This method was haphazard.

After the Second World War the need for a comprehensive maintenance schedule became apparent, and an effort was made to persuade constructors to produce maintenance manuals of a wider scope. The realization that it was unreasonable to expect maintenance engineers to possess vast experience and precise judgment led to the development of the Maintenance Schedule for routine servicing and the overhaul of those parts of the aircraft which hitherto had been overhauled at 12-monthly intervals. Thus the maintenance and overhaul of aircraft became related to "flying hours completed" instead of to calendar time.

This method attempted to determine how long the numerous parts, instruments and accessories would operate before the failure-rate reached unsatisfactory proportions, and then to replace them with new or reconditioned parts. This meant that a recognized procedure for removing engines and airscrews at agreed periods for overhaul was extended to other parts of the aircraft, and such parts given a "life." Each part must be designed to provide the maximum reliable life between overhauls, that life being determined by suitable bench-tests before the aircraft went into operation. Later operating experience would vary the lives initially established.

Increased utilization was only one reason for this conception of maintenance. Since fatigue in aircraft structures had become recognized the "lifing" of parts had assumed new importance and a final point was again that of complexity. Thus the main objectives of component-lifing were: (a) to keep the defect-rate to a low level; (b) to avoid the need for unplanned replacements; and (c) to allow complicated parts and components to be overhauled by specialists in properly equipped workshops.

As already stated, one of the objects of fixing a life was to minimize the frequency of defects. If this were achieved, safety would be improved and the need to remove defective items at inconvenient times would be reduced.

The first problem to be examined was the extent to which the fixing of life achieved this object. British European Airways had made available for examination a large number of defect-records of instruments and equipment. The striking conclusion from the majority of these records was that the likelihood of a defect occurring was *the same* early in the life of the item as later in the life. The defect rate remained fairly constant over the whole life of the item, as shown in Fig. 2.

The significance of this was that in the majority of cases, if the lives had been fixed at a half or a quarter of their present values, the number of defects would not have been reduced, and hence no improvement in safety or reduction of the work of removing defective items would have accrued.

If the defect-rate of an item was high, then the proportion reaching the lives at present fixed was not large (Fig. 3). For such items, further increase or total abolition of life might not alter the defect-rate materially. On the other hand, for items with constant low defect-rates, the majority survived the present life. The drawback of fixing a low life was that it resulted in the operator doing much more work by virtue of the very frequent removal of items. Thus, unless these low lives resulted in considerable reductions in defects (and hence reduction of the unplanned removals) the low life caused penalties with no offsetting advantages. Fig. 4 showed that the life should be as high as possible in order to avoid unnecessary work, always provided that increase of life did not result in a sudden worsening of the defect-rate.

This preliminary investigation showed that shortening lives did not generally improve the defect-rate, so that it was necessary to look to design, construction and possibly overhaul methods if the rates were to be improved.

With engines, the problem was usually more straightforward than with the remainder of the equipment of the aircraft. Overhaul lives were fixed according to such factors as test results, experience and local conditions. Thus, with new engines the periods were invariably low, but were extended according to the results of operating experience (Figs. 5 and 6).

Performance requirements were based on assumed engine-failure

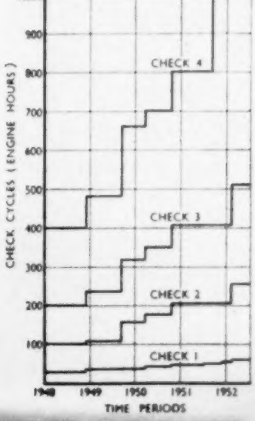


Fig. 6 (left). Extension of Viking engine check cycles against time.

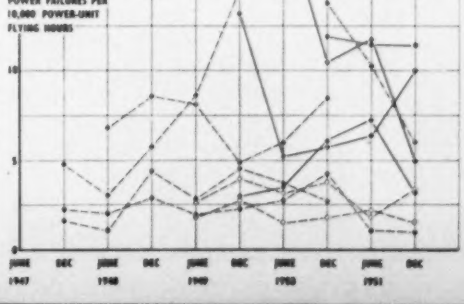


Fig. 7 (right). Trend of in-flight power-unit failure rates for U.K. scheduled operations. The points in the diagram indicate the average power-unit failure-rate for the previous six months compiled on the number of reported complete in-flight power-unit failures.

AIRWORTHINESS IN OPERATION . . .

rates, and it was therefore extremely important to maintain engine reliability at least up to the assumed figure. Thus, if engine failures increased considerably in number, it might be necessary to stiffen take-off and climb performance requirements, operate at lower weights, and limit the length of over-water flights, with a resultant substantial economic penalty. On the other hand, if the reliability of turbine engines could show an improvement over present piston-engines, it might be possible to ease performance requirements.

Fig. 7 showed the trends of power-failure rates, and it was to be noted that the older types were generally more reliable than the newer ones. It was also noteworthy that several years often elapsed before any substantial improvement in failure-rate was achieved. Assuming complete independence of the power units, the risk of two engines failing was shown in Fig. 8. The rapid rise of the risk of double power failure as the ordinary single power-failure rate increased was rather striking. The probability of double failure in a "twin" was less than in a "four," but the consequences were much more serious. If the mechanical and electrical independence of the power units were not maintained, the consequences to safety could be alarming. These precautions were likely to be wasted if, for example, all engines were changed at the same time and, due to some error, the same mistake in assembly or adjustment was made on each engine. The staggering of engine replacements, therefore, seemed desirable, together with a very careful check of fuel, oil and other fluids.

Of equipment reliability, the lecturer said it was an unfortunate fact that many important items did not reach a sufficiently high standard of reliability, and it was necessary to make provision for a high failure-rate. Necessary precautions, such as duplication and the provision of alternative systems, themselves caused new airworthiness problems, because increased complexity was usually the result.

An example of the problems associated with complexity was to be seen in the power-operated control. The advantages of such a control for high-speed large aircraft did not need to be re-iterated, but the airworthiness viewpoint was concerned only with its reliability. Broadly speaking, "power producers," whether hydraulic, electric, or pneumatic, were not so reliable as the human being. Nor were electric leads or hydraulic pipelines so reliable for transmitting power as was a simple cable or rod. Hence, duplication of the power systems became necessary.

The power-operated control also raised questions about human reactions. Since the operation of such a control was equivalent to turning on a tap or moving a switch, the feature of a manual control of natural "feel" was lost, although complex ways of building-in artificial feel were available.

Turning now to structural reliability, the lecturer said that flying higher, faster and for longer periods had brought new problems to light. It was well known that British jet transports operated at heights of up to 40,000ft with a cabin pressure of about 8 lb/sq in. This high pressure-differential demanded a cabin structure of great reliability, because explosive decompression and the effect on occupants could not be tolerated.

Plastic transparencies such as cabin windows could suffer from two main defects—cracking and crazing, neither of which was acceptable. A recent technical instruction issued by the de Havilland Aircraft Company on this subject provided an excellent example of the specialized guidance now being given to operators and maintenance personnel, and was extremely detailed. The instruction had been issued after the constructors, by exhaustive tests, had established that explosive decompression was likely to be as rare as structural failure of a wing.

The penultimate section of Mr. Hardingham's paper dealt with maintenance of performance. It pointed out that the validity of the published performance information in the Flight Manual depended on the gross performance on which it was based, being a fair representation of the average performance of *all* aeroplanes of the type, taking into account any slight variations in each. There was, therefore, a reasonable case for a comprehensive check by flight-testing of each production aeroplane of the type, followed by a periodic check, say once a year, of each. The flight tests would show (a) whether the performance of a particular aeroplane was unduly low, and (b) whether there was any significant downward drift in the average performance of the fleet.

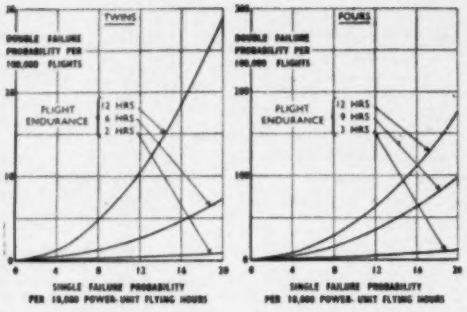


Fig. 8. Relation between single and double power-unit failure probability and flight endurance for twin- and four-engined aircraft.

Possible causes of a deterioration in performance included: (a) excessive periods between engine overhaul, which might lead to a falling-off of power; (b) repairs which left the aeroplane less clean and which increased drag; (c) repairs which reduced thrust, e.g., excessive cropping of aircrew blades; and (d) changes in specification of fuel.

The periodical testing of performance fitted in well with the continuous maintenance and overhaul system since, from the point of view of checking fleet performance, it was desirable that aircraft should be tested in randomly selected mechanical conditions, i.e., not tested immediately following overhaul.

The lecturer further suggested that when a type of aircraft had been in operation for two or three years, and if significant statistics were available, it should be possible to increase the operating weight or the scope of operation which it might undertake, on the grounds of proven reliability.

In the concluding section of his paper the lecturer said that he had endeavoured to show how the task of operating and maintaining the modern transport aeroplane was tending to become increasingly onerous. Accident statistics—which showed a low percentage of accidents due to lack of airworthiness and a high percentage due to human error—merely indicated, in the author's opinion, that the operation and maintenance of the modern complicated aircraft made for too great a demand on the skill and vigilance of aircrew and engineers.

Operators of large aircraft were turning to the synthetic training of aircrew by flight simulators—a regrettably necessary step, due entirely to present-day complexity.

Undoubtedly the greatest single contribution to safety was the provision of low speeds for take-off and landing. Assuming the demand for high cruising-speed remained, devices were necessary for low-flight speeds of the order of 50 m.p.h. in order that the operations of take-off and landing would become less hazardous and less difficult for the pilot to execute. Apart from the obvious gain in safety, the economic gain in runway lengths would be enormous.

Finally, the development of approach and navigational aids which would tell the pilot *exactly* where he was (and would present the information in a form *not* requiring great skill in interpretation) would be another step forward in the quest for safety in air transport operations.

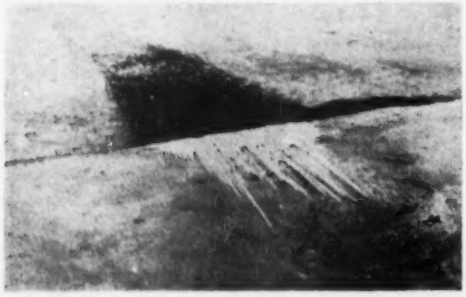
It was the author's opinion, in conclusion, that air transport in its present form should be regarded as a measure of our ambition rather than our achievement. The aircraft of today was a transport vehicle of enormous potential; but there must be a period of consolidation of effort devoted to making the vehicle more reliable, and less exacting on the people who flew and maintained it. The attitude to adopt seemed to be summarized in the words of Macbeth, "To be thus is nothing, but to be safely thus."

PROTECTING APRONS FROM JET-BLAST

A PROBLEM of increasing acuteness as more and more gas-turbine aircraft go into service is that of the damage to tarmac caused by jet efflux. It is at present of greatest significance on military airfields, but, as jet transports go into service, the same difficulty is certain to arise at civil airports. With temperatures at the point where the jet steam strikes the ground amounting to perhaps 150-200 deg. C, and at a velocity of some 1,800 ft/sec (1,200 m.p.h.), damage is certain to be caused, especially to the ordinary bituminous or tar-surfaced apron.

Shell's Thornton Laboratories, in Cheshire, have been studying the problem, and a new surfacing material, known as the Jet-resistant asphalt carpet, is the outcome. It is stated to have given excellent results during a long series of tests conducted in several countries. Also, it provides protection against damage by the spillage of special-purpose fuels.

The accompanying photograph of two test surfaces gives some idea of the results obtained.



Untouched photograph of an asphalt-laid surface after subjection to turbojet efflux at full power. The section in the background consists of normal asphaltic concrete, and has disintegrated badly; the foreground, overlaid with the new Shell surface, is merely scored by stones blasted from the untreated section, which has suffered in the usual manner.

RADIO-AID ACCURACY

How it is Maintained by the M.C.A.

IT is doubtful if any other factor has been of such great assistance to the development of safe and regular air transport as the world-wide acceptance of ground radio-aids. Communications radio has been carried in commercial aircraft for over thirty years and today the facilities available over large areas of North America and Europe include communications, D/F, radio ranges, various types of distance-measuring equipment, bad-weather aids, landing aids, position-finding or navigational aids, and terminal-control equipment. Additional equipment carried entirely on board the aircraft can give precise height indication, or warning of the proximity of storms or high ground.

The safety-value of such aids can readily be appreciated even by the chairborne, and certainly needs no commendation to the pilot; but that value is largely nullified if the equipment is not kept to a reasonable standard of operational accuracy. In fact, if wrong indications are given, or if the pilot is misled by false secondary emissions, then the aid can become a menace. To guard against such occurrences there now exist specified standards to which all ground radio aids must conform; and it is the duty of the administering authority—in this country, the Ministry of Civil Aviation—to maintain the equipment to the prescribed tolerance.

This work requires air-calibration at regular intervals. In the United States, each of the regions of the Civil Aeronautics Administration maintains a small fleet of aircraft, some of which are fitted expressly for this purpose. The C.A.A. show a strong preference for the DC-3 for calibration and their example has, as is to be expected, been followed by certain other countries. Payload is the limiting factor, for a duration of at least five hours is desirable. In Great Britain, the M.C.A. have shown that calibration can be undertaken with much smaller, and more economical, aircraft. The Percival Prince and the de Havilland Dove are the types used by the M.C.A.—with complete success—and it is worth examining their equipment in some detail. The objection can be raised that "calibration should be done by the airliner which will use the aid," but no country can afford this ideal. It is, in any case, an objection which stands up poorly to examination.

There appears to be no reason why monitoring and field-strength measurement of non-directional equipment—MF beacons, for example—cannot be carried out on the ground. But where radio patterns are involved, as distinct from simple signals, measurement must be effected from an airborne vehicle. Once established, radio beams do not necessarily maintain their original characteristics; the nature of the fluctuation is imperfectly understood, but variation of soil-conductivity with moisture-content is one disturbing factor and the presence of metal-reinforced runways is another. Main seasonal variations can be countered by pre-set adjustment, but this is insufficient in itself. Some checking with ground aerials is possible, even with ILS; and balloon aerials have been mooted—over the outer marker, for example; but one can hardly fly a balloon in the line of the QDM in use!

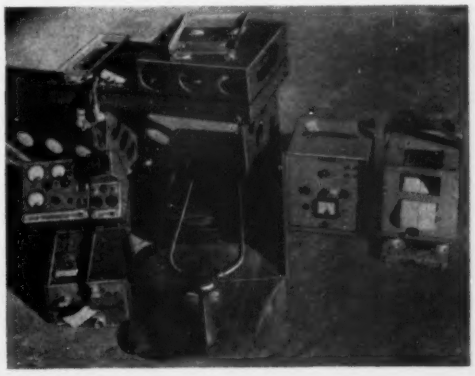
"Flight" photograph

The technical observer—on M.C.A. radio officer—"injecting a blip" on the pen recorder during a calibration with a Dove last week.

The M.C.A. installations in the United Kingdom are now checked in all weathers to maintain the prescribed tolerances. Checking is also required in the investigation of complaints, or to provide data for post-accident inquiries. The M.C.A. Flying Wing is based at Stansted Airport, Essex, under the command of G/C. G. F. K. Donaldson, D.F.C., A.F.C., (who has raced Helliwells' Globe Swift during the past season). Helliwells are under contract to the M.C.A. and have carried out the entire task of equipping the newest calibration aircraft; the design-work is done at the company's Walsall division to M.C.A. specification.

In the Dove G-ALFU the following has been introduced without difficulty: MF/HF W/T and R/T; 140-channel VHF R/T; intercom.; radio compass; SBA; ILS; Decca; radio range receiver; radio altimeter; autopilot; two instrument recorders, one pen and one photographic; drift sight; F-24 camera; and—awaiting installation—Zero Readers and Decca Flight Log. All the main flight instruments are duplicated in the cabin, where four seats are provided, although work normally requires a crew of two only. Additional ground equipment may also be involved where extreme accuracy is required, such as long-focus cameras—F-24 with a 20in lens—or a recording theodolite, used in conjunction with index marks on the aircraft.

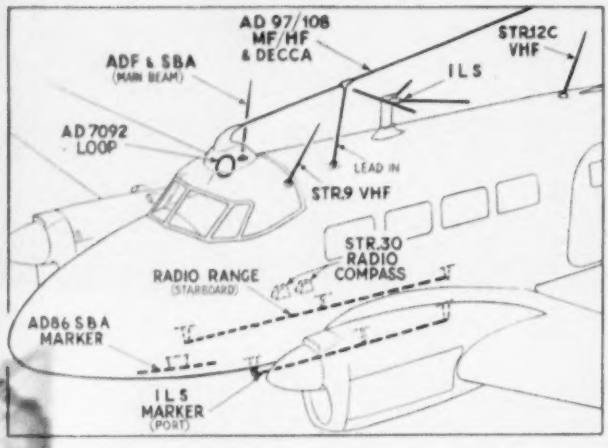
The actual equipment used is as follows: Standard STR.9; STR.12C (duplicated); SBA.193A; Ultra intercom.; SR.14-15 ILS; AD.7092; STR.30; AD.86; Decca with one set of standard Decometers, Lane Identification and Flight Log (pilot type); and, soon to be installed, Ferranti DME. The pen-recorder is an Esterline Angus product, with DC amplifier. This unit hails from Indianapolis, and it appears that no English equipment is suitable for airborne work. Signals to any instrument can be jacked into it. The instrument camera is an F.73, and the box in which it is



The complete assembled portable flight-checking equipment weighs but 112 lb. The ILS aerial is mounted on the escape hatch in front.

Taken ten minutes after the photograph on the left, this illustration shows the normal radio replaced by the test receivers and ILS indicator.

"Flight" photographs



Although by no means a standard layout, this sketch serves to indicate the variety of aerials required. The ILS glide-path "cat's-whisker" is to be re-positioned above the nose of the aircraft.

RADIO-AID ACCURACY . . .

mounted is fitted to receive suitable combinations of instruments, Veeder counter, and a clock. Its use is primarily intermittent—as, for example, during bad-weather VOR calibration, when the camera might be used to tie up the VOR indication with the Decometers every 10 seconds.

In service, all the equipment is carefully checked before and after each calibration. For ILS measurement, the aircraft makes numerous approaches down the beam and the pen recorder is used to keep an accurate record of field strength while the position of the aircraft is checked; the usual instruments for the latter purpose are the Decometers for range and the radio altimeter for height. These (and sometimes other) instruments are photographically recorded and the results analysed on the ground. It is the ultimate intention of the M.C.A. to equip the calibration aircraft with a mobile dark-room for air-processing film. With such a facility, the ground personnel responsible for the radio aid could be given instructions to effect an adjustment within a few minutes of the initial calibrating runs; the amended emission could then be re-checked at once.

The ILS indicator cross-pointers and other instruments are also, of course, involved in ILS work but, as we saw during a recent "job," the pilot and observer can conduct an efficient calibration without being overworked. Accurate flying is essential but error in the aircraft position—perhaps due to false radio signals—can be accurately measured by the several position-recording aids previously mentioned. The autopilot is usually engaged when the aircraft is flying down an ILS beam. DME and VOR equipment is not yet in large-scale use outside the U.S.A. but British equipment is available and will be introduced when necessary; the VOR will be linked with the ILS by approach coupling, which will provide a further means of checking air calibration.

The M.C.A. are necessarily taking radio calibration very seriously. They are, after all, the landlords at British civil airfields and to them flows revenue collected in the form of landing fees from all aircraft using their facilities. It is of far-reaching importance that, of all scheduled flights using airfields in Southern England, something less than 35 per cent are British. There is always a delicate situation when foreign traffic uses an airport and, in this country at least, no preference is given to flights by United Kingdom operators—in fact, if there is any discrimination, the foreign aircraft is the one which benefits.

In such a sphere, the M.C.A. are forced to admit that they are "always wrong" until they are proved right. And, if a foreign captain reports poor field-strength, or a wandering beam, it is up to the M.C.A. Flying Wing either to confirm or refute the complaint. They are, in this country, the final air-measuring tool, capable of checking any aid or facility offered. And they are understandably interested in obtaining I.C.A.O. approval for international use of their methods and equipment.

This leads us to an even more advanced development. At the recent I.C.A.O. conference it was made mandatory that all ground aids should reach a specified standard. It was also ruled that they should be checked at regular intervals to ensure that this tolerance was maintained. Such a decision has but slight repercussions on the United Kingdom, or the U.S.A.; but radio aids are now world-wide, and it is the responsibility of even the smallest state to conform to the I.C.A.O. requirement. And the exchequer of, for example, Hong Kong would be hard put to providing specialized calibration aircraft.

To meet this need, Helliwells have developed—to M.C.A. requirements—a portable ILS flight-checking set which can be installed in any convenient aircraft already in use at an overseas base. This equipment weighs only slightly over 100 lb and is expected to be available at a cost of less than £1,500, inclusive of all transit cases and incidental equipment. It has been designed to fit any standard S.B.A.C. racking, and can be used to monitor the glide-path modulation depth, and the signal strength of both the glide path and the localizer. It is shown in the photographs at the foot of page 447.

The intention is that, when a calibration falls due, the resident authority for the aid shall hire an aircraft—a Dove, in all probability—from a local operator, for perhaps one hour only. In this time, the equipment will have been installed, the original forward escape-hatch replaced by a similar hatch fitted with an aerial, and the entire calibration completed.

Having set up the two-pen recorder, the crew of two can record both glide-path and localizer readings. For navigational purposes, information obtained from the drift sight, or any other suitable source, can be injected by pressing a button to produce a "blip" from one of the pens. The other pen can similarly record blips wherever, for example, the modulation is poor. This neat, portable apparatus is by no means confined to ILS work: it can be adapted for use with ADF or any other facility.

When the results have been committed to paper and film, ground analysis can be undertaken on the spot if required or—preferably—at a central establishment. As a general rule, both with this portable set and with fully-equipped specialist aircraft, one hour of air work entails about one week of study on the ground. But the ground analysis costs no more than about £10, whereas the same results obtained directly from air measurements, without recording, would involve much more flying and would cost a minimum of £200.

This leads to the final, and unexpected, development. The M.C.A. are "working themselves out of a job" in that they are confident that air calibration will eventually be rendered unnecessary. Constant, regular checking of every radio facility is bound to lead to a precise knowledge of the variation of these aids and the ultimate goal is the achievement of accurate forecasting of expected variation—or, alternatively, the knowledge that the aid in question does not vary at all. When this ideal state is reached, all ground adjustment will be effected from previously determined data and the elimination of air checking will be reflected in a suitably revised ministerial budget.

As a final point, it is worth recording that the present calibration aircraft are kept as "normal" as possible, and A.R.B. approval is sought before any intended modification is made. The Doves and Princes have normal unrestricted Cs. of A., and are frequently called upon to undertake passenger transport.

NAVIGATIONAL VADE MECUM

"The Air Almanac, January-April 1953." Published jointly by Her Majesty's Stationery Office, London, and the United States Naval Observatory, Washington. Price in U.K., 10s.

THE British *Air Almanac* and the *American Air Almanac* have been combined, and this is the first volume of the new publication, compiled jointly by H.M. Nautical Almanac Office, Royal Greenwich Observatory, and the Nautical Almanac Office, U.S. Naval Observatory, and intended to meet the general requirements of the military forces of Britain, America and Canada.

To the British reader, the most noticeable addition is that of three sets of diagrams intended to assist the recognition and identification of planets and stars; these are the planet-location diagrams on the "daily" pages, the sky diagrams, and the star charts. Semi-duration diagrams for rising and setting phenomena in high latitudes, and a more complete refraction table, are also new. The form of the daily tables and those of "corrections for height" to times of sunrise, sunset and twilight has been revised.

These changes, which alter the internal appearance of the almanac noticeably, do not, however, affect the principles on which it is based, and will certainly not confuse a navigator familiar with the earlier editions. The new presentation of the daily tables, in particular, is most clear, and with the added use of the daily diagrams and the sky diagrams should reduce even farther the possibility of navigational errors through a misreading of the almanac's information.

✻TWO NAMES – ONE ENGINE

Keystone of the aerial defence of the North Atlantic Treaty Organisation, the Armstrong Siddeley Sapphire is now in quantity production in Britain and the United States of America.

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Would you dare?

Would you dare to send these young men off solo if you harboured the slightest apprehension about the quality of the engine to which their lives are being trusted?

Training on a large scale demands scrupulous care in every matter that affects safety. It demands the best engine obtainable.

The de Havilland Gipsy engines hold the confidence of pilots and engineers throughout the world. They may be trusted.

(Above) de Havilland Venom F.B.1s over Germany. The pilots are S/L. D.H. Seaton, D.F.C., F/L. J. R. Tanner and F/L. D. H. M. Chandler, and the picture was secured from a Meteor 7 flown by F/L. A. L. Blackman. (Below) The squadron leader's machine breaking formation.
"Flight" photographs

THE NATO EXERCISES

Part II: Flying with the Hold Fast Squadrons: Last Phases of Mainbrace

EXERCISE HOLD FAST began on September 15th. Integrated with it, as we explained last week, was a purely air exercise, known as Blue Alliance, conducted by Allied Air Forces Central Europe and engaging, to a varying extent, the Allied Air Forces deployed between Switzerland and the United Kingdom.

S/L. D. H. Seaton, D.F.C.

In addition to the British troops and R.A.F. units stationed in Germany, formations of Belgian, Canadian and Dutch air and land forces were committed in Hold Fast, the joint aims of which were to practise co-operation between Northern Army Group and 2nd A.T.A.F.; to exercise the army and air-command machinery, and to practise liaison between the respective national elements; to exercise the Northern Army Group in protracted defence under conditions of air inferiority; and to exercise

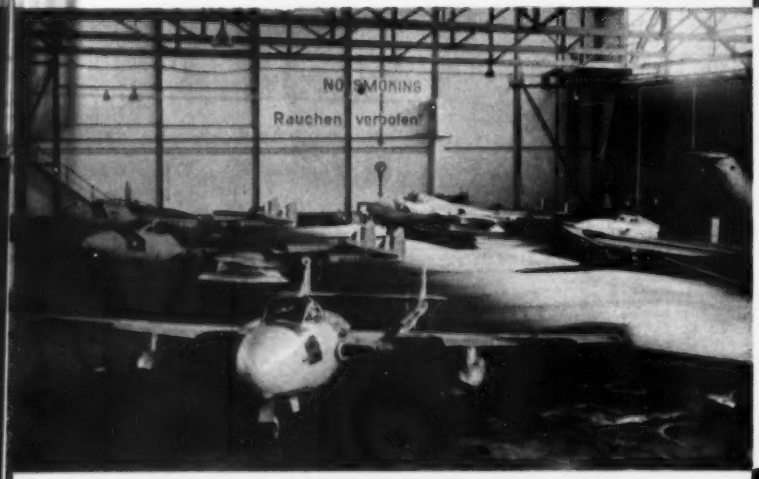
THE NATO EXERCISES...

2nd A.T.A.F. in the tactical and air-defence roles. The Director (Army) was General Sir Richard Gale and the Director (Air), General de Corps de l'Armée Aérienne P. Fay.

It was supposed that the warring nations were "Greenland"—an aggressive eastern state—and "Blueland", represented by a strip of Germany running west from the River Weser to the frontiers of Holland and Belgium. The Blueland forces were to defend the industrial Ruhr at all costs, using their armoured divisions to delay the enemy and to give the infantry time to prepare defensive systems. The onslaught of Greenland was not only to be halted, but such counter-blows were to be struck as would force the aggressors to recoil.

At Sennelager, location of the Army/Air Contrc! H.Q., we were briefed by Air Marshal Sir Robert Foster, Comma.der-in-Chief of 2nd A.T.A.F., whom we saw arrive in a camouf.aged Bristol Sycamore helicopter. Sir Robert, who was joined by his S.A.S.O., A.V-M. Edwardes-Jones, A.V-M. John Whitley, his A.O.A and G.C. Embling, Marshal of Exercise H.Q., explained that the air forces engaged in Hold Fast were rather differently placed from the land forces in that, due to their commitments in Blue Alliance, their area of operations extended from the west coast of Belgium and Holland to the west boundary of the Russian Zone of Germany. Within this broad area was the relatively small strip of country in which 2nd A.T.A.F. would give concentrated support in the land battle we have already outlined. This, Sir Robert reminded us, could be accepted as a perfectly realistic situation in that the first principle of air warfare was that the winning of the air battle came before everything else. Thus, the squadrons would not only play their full part in the land exercise, but they would be busy with high-altitude interception operations by day and night over the Dutch/Belgian air-defence zone, in the land-battle area itself, and in the back areas of the contending states, Greenland and Blueland.

Originally it had been hoped that the greater part of the air forces would be allotted to Greenland, in order to exercise the Rhine Army and the Belgian and Dutch Corps in operating under conditions of air inferiority; but conditions dictated otherwise. For the exercise of its armoured formations in peace-time the Army was restricted to certain areas, and in the case of Hold Fast the area was poorly placed for Greenland to be given the desired preponderance. Moreover, "for very good reasons," the Dutch tactical squadrons had been unable to move up to join Greenland, so it had been necessary to allot them to Blueland and to operate



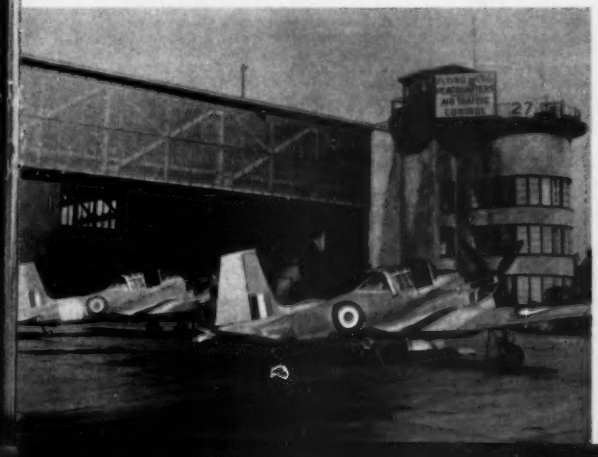
ONE of the most interesting aspects of Hold Fast was the experimental operation of a composite night-ground-attack force based at Fassberg and commanded by W/C. F. D. Hughes, D.S.O., D.F.C., who is seen below in the briefing room with Major T. Waters, the ground liaison officer. The large picture shows Armstrong Whitworth (Gloster) Meteor N.F.11s; at top left are Avro Lincoln B.2 flare-droppers, and, immediately on the left, D.H. Vampire N.F.10s. At lower right will be recognized two Boulton Paul Balliol T.2s and a pair of English Electric Canberra B.2s—the latter hangared with Vampires. All these machines were on the strength of the composite force.

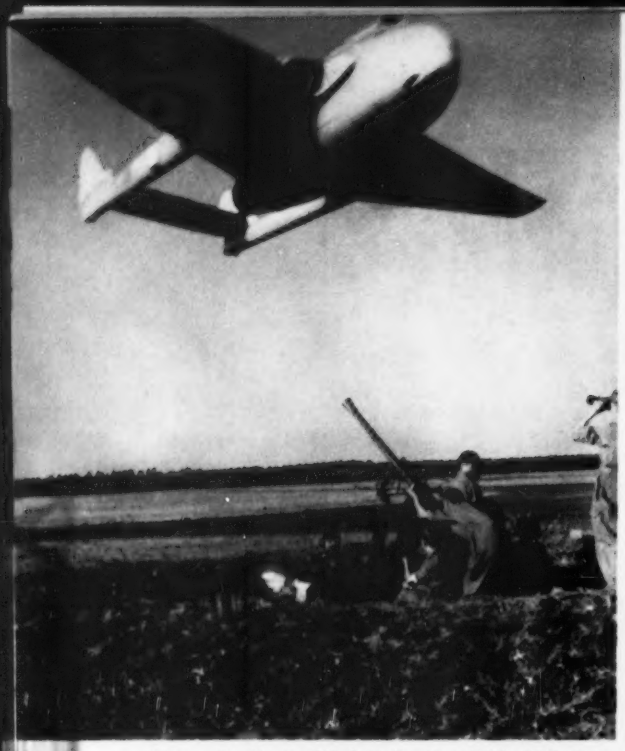
"FLIGHT" Photographs

them from their own bases in Holland. Thus, in actual fact the two sides would be about equal as far as tactical fighter/attack aircraft were concerned.

Greenland air forces were to be commanded by A.V-M. C. R. Slemon, C.D., C.B., C.B.E., of the Royal Canadian Air Force, who would use Sir Robert's peace headquarters at Bad Eilsen and would have under his command No. 2 Group, R.A.F., consisting of four wings of fighter/attack aircraft. On certain days the Greenland effort would be augmented by squadrons of U.S.A.F. F-84s, operating from American bases. There would also be a composite night-flying force, which would experiment with several different types of aircraft in evolving ground-attack techniques. Additionally, for night operations a force of U.S.A.F. B-26s (Douglas twin-engined attack/bombers) would work from their bases in the south-west. Likewise, under A.V-M. Slemon's command would be an R.A.F. reconnaissance wing of one fighter reconnaissance (tactical) and one P.R. squadron.

On the Blueland side, Air Marshal Foster would command the newly formed No. 83 Anglo-Belgian Group, which would be operating one R.A.F. Vampire wing, a Belgian F-84 wing and a wing-and-a-half of F-84s of the Netherlands Air Force. In addition there would be an R.A.F. night fighter squadron and 83 Group would control Belgian and Dutch Meteors flying from airfields more forward than their normal air-defence locations. These Meteors would have a particularly interesting role, namely, the interception of low-flying aircraft in the battle area. Also under Blueland control would be No. 69 Group—the Belgian/Dutch Air Defence formation responsible for the defence of Belgium and Holland. The squadrons comprising this group were mainly equipped with Meteors and, working from their peace





"Doing a Donaldson" : G/C. E. M. Donaldson, D.S.O., A.F.C., Station Commander, R.A.F. Fassberg, provides a little practice for some of the Bofors gunners defending his airfield in Exercise Hold Fast.

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stations, would be occupied exclusively with air defence. Finally —for the last two days of the exercise—83 Group would operate three F-84 squadrons of the U.S.A.F., based in the American Zone. Blueland's limited tactical-recce. requirements would be met by one R.A.F. squadron.

Concerning radar defences, Air Marshal Foster told us that Greenland would be covered by the Tactical Air Force mobile screen, while Blueland would be served by the static radar defences of the Low Countries, supplemented by mobile equipment of 83 Group and a line of observer posts to report low-flying aircraft.

With eight flares beneath its wings, a Balliol T.2 is seen, above, ready for night ops. Below are Vampire N.F.10s which, together with the Meteor N.F.11s, were strafing targets after sundown.

"Flight" photographs

Throughout the exercise, raiding forces of R.A.F. and U.S.A.F. bombers, operating from the United Kingdom, would provide opposition for both the Blue and Green air defences.

The "air" objects of Hold Fast were stated for us by Sir Robert as follows : (a) to give all the different Allied components practice in their war roles; (b) to test to the full the Dutch and Belgian air defences and those of the Tactical Air Forces over their forward areas; (c) to develop night-ground-attack techniques, making use of the numerous land-force targets provided; (d) to practise army/air co-operation with the British, Belgian and Dutch armies.

As the Air Commander of the part of Europe concerned Sir Robert naturally had special interests. In the R.A.F. command, he said, an exceptional expansion had taken place over the past year and he wanted to prove that high operational standards had been maintained in spite of the "very large dilution of experience" involved. He expressed the hope that the Belgian and Dutch elements of 2nd A.T.A.F. (which had been making admirable progress in training with their F-84s) would show themselves to be fully operational.

It had already been proved that the air defence system of the Tactical Air Force and of the Belgian/Dutch D.A.T. (Defense Aérienne Territoriale) could be effectively merged. This combination would again be practised and—moreover—extended, by bringing forward air-defence squadrons to operate over the battle area.

Knowing that night attacks on communications and similar targets paid excellent dividends, Sir Robert would be "extremely interested" in the operations of Greenland's night ground-attack wing.

Likewise, on the Greenland side, at 83 Group, was a fully integrated Belgian/British operational staff, and as Hold Fast would be the Group's first exercise, Sir Robert hoped to get a clear pointer that this sort of set-up was the one which should be adopted as a model for the Allied tactical air forces.

"This is the last time," he told us, "you will see us in the field with our present equipment. The new aircraft and ancillary equipment are now starting to come in and next year you will, I hope, see us operating aircraft of a very different shape and performance—and in substantial numbers, too."

We took the opportunity to question the Air Marshal concerning the introduction of Venoms into his Command, and, being assured by him that a flight would be operating from Wunstorf, we determined to pay them an early call.

At Sennelager we were able to learn in full detail the size and composition of the Green and Blue forces. About 800 aircraft would be involved in Hold Fast (the total for Blue Alliance would be about 1,200) and the troops would number some 150,000 (55,000 British; 60,000 Belgian; 28,000 Dutch; 6,000 Canadian). The armoured formations would put into the field about 500 Centurion tanks and 150-160 M.10s.

Even during our brief sojourn at Sennelager the composition of the air forces was being varied; but we give the actual strengths as we last checked them, in the knowledge that they will interest many readers (IDF=intercepter day fighter; F/GA=fighter/ground attack; NF=night fighter). Blueland : (H.Q. 83 Group) one R.A.F. F/GA wing of Vampire 5s at Wildenrath; one Belgian F/GA wing of F-84s at Florennes; two Netherlands F/GA squadrons of F-84s at Volkel and two at Eindhoven; one Belgian IDF squadron of Meteor 8s at Wahn and a Netherlands IDF squadron, similarly equipped, at Twente; a Spitfire IDF squadron at Twente; and, at Wahn, one R.A.F. NF squadron of Meteor 11s and one R.A.F. Tac.R. squadron of Meteor 9s. (H.Q. 69 Group) : one Belgian IDF wing of Meteor 8s at Chievres; two Netherlands IDF squadrons of Meteor 8s at Soesterburg; two Netherlands IDF squadrons, also with Meteor 8s, at Leeuwarden; and one Belgian IDF wing of Meteor 4s at Beauvechain.

The "actual" Greenland units were : (H.Q. 2 Group) five R.A.F. F/GA squadrons of Vampire 5s at Celle; two R.A.F. F/GA squadrons of Vampire 5s at Oldenburg; three R.A.F. F/GA squadrons of Vampire 5s at Buckeburg; three others, similarly equipped, at Wunstorf; one R.A.F. Tac.R. squadron of Meteor 9s at Gutersloh; one R.A.F. night ground-attack wing (made up of one squadron of Meteor 11s, four Canberra B.2s, four Vampire N.F.10s and three Balliol T.2s) at Fassberg; one R.A.F. Venom F.B.1 flight at Wunstorf; one R.A.F. P.R. squadron of Meteor 10s at Gutersloh, and four night-P.R. Mosquitoes, also at Gutersloh.

We learned that British paratroops would be coming out from the U.K. to join the Greenland side, though their intended operations were kept very quiet, even at Sennelager.

On September 16th we set out in clear, bracing weather to see the war, and directed our borrowed Volkswagen towards Wunstorf, where we were made welcome by the station commander, G/C. P. R. Jameson, D.S.O., D.F.C., and his "Wingco Flying," W/C. J. T. Shaw, D.S.O., D.F.C. The squadrons of the Vampire wing operating from Wunstorf were the commands of S/L. Daw, D.F.C., A.F.C., S/L. Sutherland, D.F.C., and S/L. Coulthard. The Venom unit, responsible for the Service trials of the type, was led by S/L. D. H. Seaton, D.F.C. Attached for the period of the

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THE NATO EXERCISES...

exercise were two additional Venoms from the Central Fighter Establishment in charge of S/L. Oxspring, D.S.O., D.F.C., and S/L. Vaughan-Fowler, D.S.O., D.F.C.

Concealed in the fringing woods we found the "Wing Ops." vehicle with its four satellite self-movers—for air-traffic control, A.A. gun control (R.A.F. Regiment), the ground liaison officer and the met. section—and here we heard that two Venoms had been airborne before dawn, intent on strafing aircraft at Eindhoven Volkel and Beauvechain. Arriving over their targets at first light they caught the Bluelanders *en déshabillé* and returned triumphant after 50 minutes.

The Venoms—single-seat F.B.1 fighter/bombers—were operating freelance and were not under the jurisdiction of the exercise controllers; they could be called upon to intercept raiders only if they themselves happened to be airborne when the warning came in. It was the task of their pilots to amass as much information as possible on operational and other characteristics of the Venom so that the behaviour of the type in full squadron service could be forecast. Like the example statically shown at Farnborough the other week, the Wunstorf Venoms were camouflaged in green, grey and blue and—especially with tip-tanks in place—had an uncommonly business-like air. Particularly did the pilots appreciate their excellent rate of climb and quite exceptional high-altitude manœuvrability, and, though well aware that such machines as the F-86 were much faster, they were not the least bit despondent, in the knowledge that a Venom could quite easily out-manœuvre an F-86—should one stop to play. "We're prepared to go to war with our Venoms any time," said one pilot; and we believed him, though we did not forget that the wing loading of the Mig-15 is lower than the Sabre's. As we talked, S/L. Seaton landed back from a brush with Vampires and Meteor P.R.10s and left us in no doubt that he shared the opinions of his pilots.

Like the reheat Venom flown in the Farnborough Display, those at Wunstorf were marked with red bands on the wing. These signify a temporary manœuvring restriction on the early-production machines and will not be seen on later batches. The Ghost turbo-jets had cartridge starters.

Although we did not expect to find a great deal of activity in the battle area at this time (and so were not disappointed when this expectation proved correct), we welcomed a sight-seeing trip in a Meteor 7 flown by F/L. P. M. Marsh, who commands the Wunstorf Meteor flight, and is responsible for instrument ratings. This knowledge we found reassuring when, just after we had left the ground, he shut one Derwent down and explained over the intercom. his intention of "flogging round on one" for the rest of the trip to protract our endurance (for we were at a low, and consequently uneconomical, level). Though our Meteor was a well-worn one, we noted that 13,000 r.p.m. on the live engine gave about 260 kt cruising speed.

From Wunstorf we passed over Hamelin and weaved our way down the Weser; then down to Warburg, up Blueland's defensive Lion Line to Detmold, along the northern border of the battle area, turning south at Gutersloh down Tiger Line and turning again at Buren, where the red light showed that our ventral tank had emptied. Then homeward, with such landmarks as the Minden Gap and Steinhuder Meer to catch the eye, though we immediately put these from mind when F/L. Marsh warned us that he was about to relight the port Derwent. This entailed throttling back the live engine until the r.p.m. of the dead one fell to somewhere between 800 and 1,000 (for at our best-range speed of 260 kt it was being turned over by the air-stream at about 2,000 r.p.m.); then the throttle of the dead engine was opened one-third, the relight button was pressed, and, as the revs built up, the high-pressure fuel cock was brought in. The r.p.m. of both Derwents were then equalized and the rudder trim wound off.

We landed with 120 of our 500 gallons of kerosine remaining, having been airborne for 55 min at low level. The flight lieutenant estimated that, had both Derwents been operative, we should have had to return 15-20 min earlier.

Altogether an edifying introduction to the capabilities of the Meteor at low level.

Lunching in Wunstorf mess (having dropped in from their base up at Fassberg, a few miles from the border of the Russian Zone) we came across G/C. "Teddy" Donaldson and W/C. Smith, his W/C. Flying. The group captain having assured us of a welcome at Fassberg, we decided to press on in the "Volks."

As he wished us goodbye, G/C. Jameson told us that, while flying that afternoon in his Vampire (having gone aloft to appraise the airfield camouflage) he had spotted a contrail heading east, with a pair of Venoms in pursuit. Surmising that the raider responsible would return the same way, he waited, and eventually made contact with a B-45 Tornado at 36,000ft. The Vampire, he told us, was quite able to hold its quarry at this height, even on the climb, though the American bomber may not have been flying all-out.

Fassberg, as we have remarked, was the base of Greenland's night-ground-attack wing, under the command of W/C. F. D. Hughes, D.S.O., D.F.C., O.C. All-weather Wing, Central Fighter Establishment. Though the hour was late when we arrived, and he was busy with details of imminent operations, the wing commander found time to acquaint us with his singularly interesting composite force (upon the heterogeneity of which the station commander lost no opportunity of pulling his leg, in characteristic Donaldsonian manner).

The variety of the aircraft comprising the force was, in fact, even wider than we had been told at Sennelager, for in addition to four Canberra B.2s from Binbrook, there were Meteor N.F.11s and Vampire N.F.10s from three famous night fighter squadrons, three Balliol T.2s of the C.F.E., and two Lincoln B.2 flare-droppers from Hemswell. By flare-light a number of these midnight marauders had already been making good practice with live bombs and cannon against objects on the Sennelager ranges, the Canberras, of course, doing the bombing, with the Meteors and Vampires raking the designated targets with their 20 mm cannon. Though we were not able to study the assessments made by the Operational Research Branch of T.A.F. H.Q., we believe the results to have been quite remarkably good—in particular those achieved by the Canberras, under F/L. D. R. Howard, D.F.C.

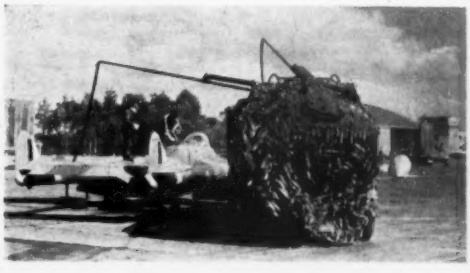
It is worth noting that in the Korean campaign B-26 bombers have been quite extensively used for low-level night attacks and that T-6s (Harvards) have played a part similar to that which fell to the Balliols.

We listened to briefings, successively by the air liaison officer and W/C. Hughes, for a series of attacks on Blue communications —particularly traffic on the roads radiating from the town of Paderborn, which carried the troops moving up to the Lion Line. When everything was set for action about midnight we accompanied the wing commander to the met. office, where the German civilian in charge (one of many who are doing an excellent job in this capacity for the R.A.F.) immediately blighted our hopes with a firm forecast of fog. But at Fassberg the night remained perfectly clear and starry and W/C. Hughes went ahead with arrangements for us to accompany him on a flare-dropping sortie in a Balliol and later to fly on a strafing expedition with S/L. A. Jaccmb-Hood in a Vampire.

As we waddled out, parachuted and helmeted, to board the

The strange-looking monstrosity on the left is a camouflaged refueller ministering to a Venom; on the right, polish is being applied to a newly camouflaged Vampire. Formerly Vampires were silver-finished.

"Flight" photographs



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Balliol we looked forward to a most interesting and, literally (for we noted that the Balliol had eight flares beneath its wings) illuminating evening.

Except for the faint glow of the instrument dials and the thin beam of the wing commander's torch as he made his checks, the Balliol's cockpit was as black as the grave. There was no time for loitering, for the treacherous mists were threatening out over the plains; so the Merlin 30 was brought into flaming, sparking, thundering life, and we tucked our right elbow in as the wing commander closed the lid over us. Our own seat was lower than we could have wished, but we decided against trying to raise it to improve our view lest we should pull the wrong lever in the pitch blackness, with untoward results.

Guided (though we ourselves found them utterly confusing) by thousands of blue ground lights, we picked our way out to take-off position, and W/C. Hughes received his R/T. clearance from flying control. The Balliol lunged forward and almost immediately was nosing up into the blackness above.

On course for the target area we were greatly aided by the lights of towns, including those of Belsen, and with 150 kt or so on the clock (the flares were cutting the Balliol's speed by about 15 kt at 2,000ft) we progressed well enough until, quite suddenly, banks of mist began to confront us. We were somewhere near Wunstorf when, with mixed feelings, we received R/T. instructions to return to base. The operation had been called off.

But having got us airborne, W/C. Hughes was evidently going to make the best of a disappointing situation, and we heard him request permission to drop a flare when we arrived back over Fassberg. At about this time we also heard the pilot of a second Balliol, airborne after ourselves, reporting engine trouble; he was eventually directed home and arrived there without further incident.

So, back over Fassberg once again, the wing commander duly released a flare which we watched falling astern on its parachute, trailing its tall smoke plume and lighting up the airfield below. "Then having dropped the flare," the wingco went on, after renewed apologies for our abortive mission, "we go in like this." He stood the Balliol on end and we bore down on the dispersed aircraft which showed up strongly in the flare-light, making a memorable picture.

Before coming in for a landing he threaded the Balliol among the beams of the searchlights coned directly above the airfield as a beacon—for with the Russian frontier just a few miles away no unfortunate errors of navigation are being risked. "Too bad you couldn't have the full treatment," he said as we headed egg-and-baconwards. But we had seen enough to convince us that the problem of ground attack by night is being tackled by the R.A.F. with imagination and resourcefulness, and by pilots and aircrew of the right sort.

Next day we tried to bring ourselves up-to-date on the progress of Hold Fast, and the following is the gist of a typical operational summary (actually until 1500 hr Z on September 17th) from Green air force: Sorties flown, 12 P.R. in single, 22 Tac/R in pairs, 21 intruder, 44 armed recces., 71 ground support. Claims, 6 Meteors in airfield attacks, 1 Centurion tank destroyed, 3 Centurions damaged, 14 anti-aircraft guns destroyed, 10 soft-skinned vehicles destroyed and 13 damaged, 1 W/T. truck destroyed, 1 H.Q. destroyed. Simulated medium bombing attacks on airfields at Volkel, Wildenrath and Soesterburg. Armed recce. on ridge positions not very successful owing to good camouflage and dispersal. Fifteen interceptions against B-50s and B-45s. A Blue-land summary claimed 21 F-84s, 5 B-36s, 6 Dakotas, 6 Vampires and 11 B-50s destroyed.

Back at Sennelager we heard that two strangers in mufti—a de Havilland Beaver and a Scottish Aviation Prestwick Pioneer (both loaned by their makers)—had been engaged on communications work, and that Air Marshal Sir Robert Foster had used the Pioneer to meet Field Marshal Earl Alexander, Minister of Defence, at Gutersloh on September 16th. Distinguished observers of the exercise, other than the Field Marshal, included Prince Bernhard of the Netherlands and the NATO Defence Council, headed by its chairman, Lord Ismay.

By September 20th the weather had begun to deteriorate, but air operations continued on a reduced scale and there was a drop by territorial parachute troops near Unna on the evening of September 20th. Some 400-strong, the force was composed of men of the 46th Parachute Brigade of the 16th Airborne Division and was flown out to Germany in Fairchild Packets of the U.S.A.F. On its return to Renfrew, on September 21st, the pilot of one of these aircraft suspected undercarriage trouble and ordered the parachutists to bale out. It was subsequently found that the wheels were, in fact, down, and that the fault concerned only the undercarriage indicator light.

H.F.K.

At Bodø Eilsen (left to right): W/C. R. R. Mitchell, R.A.F., 2nd T.A.F. H.Q.; A.V-M. J. L. Plant, R.C.A.F., Deputy Chief of Staff, Logistics, H.Q. A.A.F.C.E. (visiting); G/C. S. H. C. Gray, R.A.F. (H.Q. A.A.F.C.E.); A.V-M. T. G. Pike, R.A.F., Deputy Chief of Staff, Operations (H.Q. A.A.F.C.E.) (visiting); A.V-M. C. R. Slemon, R.C.A.F. (A.O.C.-in-C. Greenland Air Forces); and W/C. J. C. Wells, R.A.F. (A.A.F.C.E.).

MAINBRACE ENDS

THE concluding stages of the "Mainbrace" operations (we described the early phases last week) were affected considerably by bad weather. Storms over Scandinavia and the North Sea caused Allied amphibious landings to be postponed, and the extent of aerial activity on both sides to be severely curtailed.

In Northern Norway, Allied carrier-borne aircraft continued their attacks on land targets, under the direction of the ground-control teams and, in the final stages of the operations in this area, parachute drops of supplies were made from transport aircraft to the Blue forces. The Blue carrier striking-force, under Vice-Admiral Felix B. Stump, U.S.N., then moved south towards Denmark, and a further support carrier-force sailed from Rosyth in advance of the amphibious landing force, and headed towards Denmark also. Orange aircraft of Bomber Command were active in night raids at this stage, and succeeded in finding the fleet, but were intercepted by night fighter aircraft from the Blue carriers. Other attacks on surface vessels of the Blue fleet were made by Norwegian F-84s and Danish F-86s—with some success—and a Coastal Command Neptune from Kinloss succeeded in "killing" an Orange submarine 90 miles east of Aberdeen.

The last phase of the exercise again involved the support of Blue land forces by carrier-borne aircraft, as at Bodö. Operational control of the aircraft over Denmark had been delegated by Maj.-Gen. Carter to Maj.-Gen. Gage Andersen, Royal Danish Air Force, assisted by his ground-control teams, who guided the naval aircraft to their targets in a large number of sorties. Once again, however, as in Norway, gales made continued operations on a large scale impossible, unavoidably limiting the test of Allied organization. Opposition to the ground-support aircraft was provided by Orange land-based day fighters, and Bomber Command aircraft continued to attack the Blue fleet. Strong forces of Washingtons and Lincolns made successful high-level attacks in the bad weather, using radar, but 14 Canberras from Binbrook, attempting a visual raid as their first "Mainbrace" operation, were prevented by thick cloud from reaching their targets. On the last day of the exercise, September 23rd, in spite of rough seas and high winds, three large groups of carrier-borne fighter-bombers were able to give close support to the Jutland landing of U.S. Marines, postponed from the previous day, and Sea Hornets from a British carrier made a successful attack on H.M.S. *Apollo*, acting as an Orange surface raider.

Admiral Brind, who conducted the exercise, stated after its completion that results had been "good"; there had been small troubles, but no serious ones. In the flying operations, the need for large numbers of long-range anti-submarine patrol aircraft had been clearly shown. One of the most interesting features of the exercise, the development of the ground-controlled attacks by carrier-borne aircraft, had unfortunately been restricted by the weather; thus the lessons learned at Bodö could not be fully used in the Jutland operations.

An unscheduled entrant in the exercise was the "flying saucer" reported to have been seen by Coastal Command personnel at Topcliffe, Yorkshire, on September 20th. In the "saucer sightings and movements" file at Maritime Headquarters, Pitreavie, the object was described as "silvery white," making identification with either Blue or Orange forces difficult.

K.T.O.

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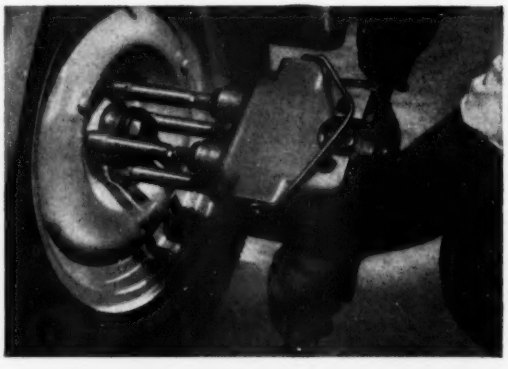

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FATIGUE in METALS

Conclusions from Major Teed's S.L.A.E. Lecture

RECENT reports of fatigue-failures in aircraft lend topicality to the lecture (entitled *Fatigue—What it is and Some Ways of Reducing its Incidence*) which Major P. L. Teed, A.R.S.M., M.I.M.M., F.R.Ae.S., deputy chief of aeronautical research and development, Vickers-Armstrongs, Ltd., read before the Society of Licensed Aircraft Engineers in Southampton on September 27th. The subject is so vast that, as the author remarked, "It will be impossible to give a detailed picture." The following, however, are the chief conclusions drawn by Major Teed in this notable paper.

In 1903, Ewing and Humfrey established that when a small stress—lower than the engineers' elastic limit—was applied once to a specimen, subsequent micro-examination showed that within a small proportion of the grains or crystals, slip planes (i.e. relative movement of planes parallel to the crystal axes) had developed. Thus some plastic, or non-reversible, yielding had taken place, even though the accepted elastic limit had not been approached. The actual deformation was confined to individual metallic crystals and was sometimes measurable only in terms of inter-atomic distances, and therefore unnoticed by the engineer. This generally minute structural change was a pre-requisite of structural failure.

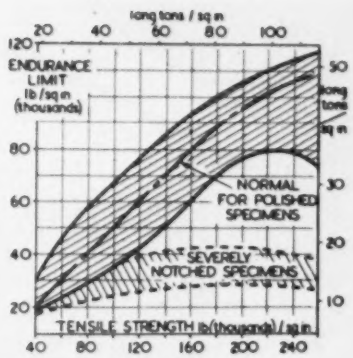
The origin of these changes was of an extremely local nature, and was evident as countless slip-planes throughout the metal. The creation of a slip band produced local work-hardening, so increasing the static strength, but reducing the ductility or capacity to resist shock. Due to the orientation, and mechanical characteristics of a crystal, or metallic grain, slip was developed on the application of the stress, but was not reversed when the stress was removed. The initial slip caused an extremely local increase in strength; the removal of the load caused the same stress to be imposed but in the reverse direction, and the local work-hardening at the original slip-plane resulted in the reverse slip occurring elsewhere—probably no more than a few atomic spacings from the original slip. Thus began a progressive change in the mechanical properties of the grain.

As slip succeeded slip, an increase in ultimate stress took place, but the elastic limit of the metallic grain increased even more rapidly. Thus the process was an embrittlement of the grain, culminating when elastic limit and ultimate tensile stress were virtually identical. An illustration [reproduced below—ED.] showed a specimen of Duralumin L38 in which a crack had developed when the two stresses had become equal; it would be noticed that the crack was parallel to the numerous slip bands.

At room temperatures, the intercrystalline boundaries within a metallic specimen were stronger than the crystals themselves. A fatigue crack thus had difficulty in crossing such a boundary; but there eventually came a time when so many fatigue cracks had developed in similarly-oriented crystals that the reduced cross-section of remaining metal could no longer stand up to the peak loading and failed. This latter failure was in no sense a fatigue failure, being a simple plastic failure due to overloading of the remaining material.

Major Teed's paper was illustrated by a number of photographs showing fatigue failures in which the two types of crack were very distinct. The fatigue crack had a smooth surface and exhibited reflecting, crystalline facets; the final, rapid failure showed a rough surface and no facets. If the broken faces were fitted together, it would be found that the rapid, final break fitted well, but that there was a gap around it; this showed that the final break had been one of plastic failure. If this part—usually the central portion of a specimen cross-section—were ground away, the slowly-developed, smooth fatigue failure would also be found to mate accurately.

The paper then continued: "It is time to get to grips with the subject in terms which to engineers are as familiar as household words. No longer can we gaze at the metallographic structure through a microscope. We must get the measure of metallic performance in terms of stress and endurance." One of Major Teed's illustrations showed a stress-to-failure/number of reversals curve plotted by T. T. Oberg at the Wright-Patterson Air Force Base. A very large number of specimens had been involved, the least loaded of which had broken only after 8,300,000,000 reversals. From such a curve one could ascertain at a glance the number of reversals which a specimen could be expected to withstand at a given stress. Thus, 1,000 cycles were possible at a stress of 36 tons/sq in., but if 500,000,000 cycles were to be met, the permissible stress dropped to but 8 tons/sq in. This emphasized the penalty attaching to the acceptance of a dynamic load.



Relationship between U.T.S. and endurance limit in notched and unnotched steels of greatly varying strength.

A further conclusion which could be drawn from this curve was that below a specified limit of stress, the specimens could withstand an infinite number of reversals. Another result was that, if a specimen were put through a very great number of reversals at a low stress (without failure) and then re-tested at a higher stress, the eventual failure was after the same number of high-stress reversals as a new specimen; thus, the long period at the lower stress did no harm.

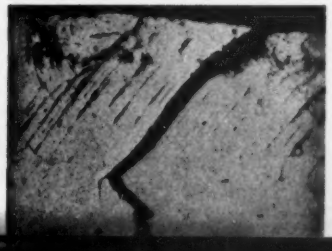
Stress concentrations due to notches were then discussed, and a table showed that a specified notch in a set of forged aluminium-alloy specimens caused reductions in fatigue endurance limit stress of between 45 and 67 per cent. It was evident that a very complex state of affairs existed in light-alloy components containing stress concentrations, and, as Major Teed's paper stated, "no one can accurately forecast the endurance of a component containing stress concentrations."

Fatigue was likely to cause failure of light alloys, no matter how small were the stresses involved; but ferrous alloys, and some other metals exhibited a "fatigue limit" of stress below which any number of reversals could be sustained. The magnitude of the cyclic stress which could be withstood by a metal, either in perpetuity, or for several hundred million reversals, was small in comparison with the static ultimate tensile stress. The influence of stress concentrations on fatigue resistance depended principally on basic material characteristics, the degree of material homogeneity, and upon the geometry of the specimen. Since only the last-mentioned could be expressed in concrete terms, it was impossible to forecast the fatigue endurance of a specimen containing stress concentrations, without prior experiment.

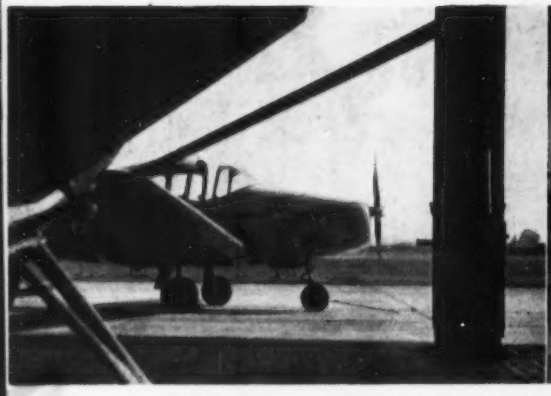
The curves shown in the illustration [reproduced above—ED.] were due to Bullens; they demonstrated that, since very strong steels were highly notch-sensitive, there was an Ultimate Tensile Stress beyond which it was inadvisable to go. It appeared to be about 72 tons/sq in. Surface finish was another factor entering into the discussion; if proper attention was paid to the finish of highly stressed areas, considerable improvement in stress and endurance could be obtained. It had been shown that the effect of the surface condition was more marked on harder steels than on soft metals. But the effect was of such importance, even on the softer ferrous alloys, that it should be a rule never to make an identification mark by stamping or by electric pencil on a highly stressed area.

The gains possible from polishing aluminium alloys had not always been of the same high order, but if the improved surface finish were obtained by abrasion, and not by causing the metal to flow (as in buffing), fatigue resistance of light alloys could be increased. Major Teed then warned against attempting to improve appearance by electro-polishing; this, together with chemical cleaning, could on occasions have a deleterious effect on fatigue resistance, and should not be adopted without prolonged fatigue testing.

A related aspect of the fatigue picture was the fact that, if one could put a residual compressive stress into the surface layers of a component, the harm done by cyclic tension could be reduced—since the actual stress was the algebraic sum of the compression and the tension. Such a surface condition could be created artificially by bombardment with chilled cast iron balls of about 0.025in. diameter. This procedure had a secondary beneficial effect in that it introduced surface work-hardening. By its use, Major Teed cited the case of a heavily loaded spring, whose life was thereby increased tenfold.



Photomicrograph (× 500) of cross-section of failure in a clad alloy, type B.S. L38.



"Flight" photographs

(Left) A Ryan Navion, one of the many Swiss-owned American aircraft to be seen at Kloten Airport, Zurich. (Right) This modern hangar at Kloten, with upward-swinging door, houses over forty light aircraft. In the foreground is HB-OKO, a veteran D.H. Leopard Moth used by the Aero Club of Zurich. A Hiller 360 helicopter belonging to Air Import, a Lausanne company, is also kept there.

SWISS FLYING CLUB

ONE of the largest and most attractive collections of light aircraft to be seen in Europe is housed in a special hangar at Kloten Airport, Zurich. During a recent visit we counted about 40 machines—of such various types as Bonanza, Gemini, Argus, Auster, Voyager, Cessna 190, 170 and 140, Piper Cub, KZ VII, Temco Swift, Bücker Jungmeister and Leopard Moth. The last-named veteran belongs to the Aero Club of Zurich, which has 11 other aircraft, some 400 members (about 150 of whom fly regularly) and its own section of the hangar. The remainder of the building is filled with privately owned machines, parked nose to tail and wing-tip to wing-tip, and all bearing on the fin and rudder the Swiss national flag—a white cross on a red background.

Despite such evidence of an active flying movement, rates for hire of aircraft and instruction are higher than they are in England. Dual costs 63 francs (more than £5) per hour, so that the price of completing 30 hours for a private pilot's licence is quite an expensive business. For the hire of a light aircraft the Zurich club charges 51 francs (about £4 5s) per hour. There is practically no state aid for the private pilot, and the club just manages to break even by giving joy-rides to passengers from the visitors' enclosure. Members and instructors, none of whom are full-time pilots, log an annual total of about 2,500 flying hours. August was a good month and the club flew 400 hours.

The only Government funds received by the club are for the annual training of between 12 and 16 cadets, who receive about eight hours' instruction, but the members themselves receive some incentive in the form of small sums of money awarded for proficiency. For example, a private pilot is given 150 francs for completing a round trip of over 600 km within a week, provided he visits a destination 80 km beyond a foreign frontier and flies in stages of at least 200 km. When his P.P.L. is endorsed for night flying he is presented with 150 francs, and aerobatic proficiency is rewarded by a further 300 francs.

As Kloten is an international terminal used by several airlines, the movements of light aircraft are subject to strict control. Pilots may make take-offs and landings only on the grass portions of the airfield (which, incidentally, form a home for several million field-mice), having first submitted a *Fluganmeldung* (flight plan) giving full details of their aircraft and its intended journey. All operations by light aircraft are under the supervision of Mr. T. Furler, an official of the airport police. He is responsible for reporting movements to air-traffic control and for recording in detail the day-by-day progress of every light aircraft at Kloten. Mr. Furler and his colleagues at other airports are thus able to furnish the Swiss Government with a detailed annual record of the activities of the country's private-flying movement. The Zurich club, incidentally, is one of 24 "power-driven flying groups" affiliated with the Swiss Aero Club, which also has balloon, gliding, soaring and model sections.

In addition to its Leopard Moth, the Aero Club of Zurich has two Ranger-powered Arguses, one Danish built KZ VII Lark, three Bücker Jungmeisters, four Piper Cubs and a Cessna 140. An Auster Aiglet, we were told, may later be added to this impressive little fleet.

R.B.

(Left) Not for ham-handed pupils, whatever the inscription might suggest to English eyes: it was seen on the nose of a Fairchild Argus used by the Kloten (Zurich) flying school. (Right) A swing-start for one of the club's three Hirth-powered Bücker Jungmeisters. These neat little biplanes are especially useful for aerobatic training.

"Flight" photographs

A de Havilland Announcement

OPPORTUNITIES AT HATFIELD

Interesting Vacancies in the de Havilland Advanced-Project Teams

Scope and Security for Top-Grade Technicians

FAR-REACHING development plans have called for further considerable expansion of the de Havilland technical team.

Technicians who combine top-grade qualifications with a high degree of enthusiasm and vision are required immediately for key posts in work on advanced projects.

The de Havilland Aircraft Company is chiefly interested in people with first-class knowledge and experience, who can command a high salary and can make their own particular mark in aeronautical development. The appointments will be permanent, progressive and pensionable.

INTER-RELATED WORLD TEAMS
It is well known that one of the bases of continued success of de Havilland products is the close co-operation between teams of technicians and operating specialists working in different parts of the world. Thus the de Havilland technician has unrivalled opportunities to widen his own scope and outlook by acquiring at first hand knowledge of technical development and operating conditions throughout the world.

In this connection it is worth stressing that the de Havilland Enterprise is the only organisation of its kind which designs and constructs military and civil aircraft, guided weapons, jet, rocket and piston engines and propellers.

ADVANCED PROJECTS: With the world's first jet airliner, the Comet, now building up to full production and the first stages of the conquest of supersonic speed passed, the Company is entering upon a new phase in its programme of work on civil and military aircraft. A whole new field of aeronautical development is now open, and for technicians able to play an effective part in a team working on many aspects of advanced design, the opportunities for real achievement—as well as for progress and promotion—are high.

HOUSING: As everywhere else, obtaining unfurnished accommodation in this area is not easy, but the Company is prepared to help surmount this obstacle by giving assistance to suitable applicants. While no definite assurances can be given, of course, intending candidates are urged *not* to allow the housing problem to stand in the way of their initial application.

Designers (structural and mechanical), aerodynamicists and stress analysts interested in these vacancies are invited to write to :—

The Chief Designer,
THE DE HAVILLAND AIRCRAFT COMPANY LIMITED,
HATFIELD, HERTS.

Movement Controlled - by the TASKMASTER

A drawbar pull of 3800 lb. enables the David Brown Taskmaster to handle aircraft up to the Convair, Viking, and Dakota class with ease and safety. The 4-speed gearbox with its low-ratio 1st gear equips the driver for full-power 'break-out' with easy under-way gear-shift to suitable working speed. The David Brown Taskmaster speeds up ground movement, lowers fuel costs, and although primarily designed for aircraft handling it can turn its hand to every conceivable haulage job around the airfield.

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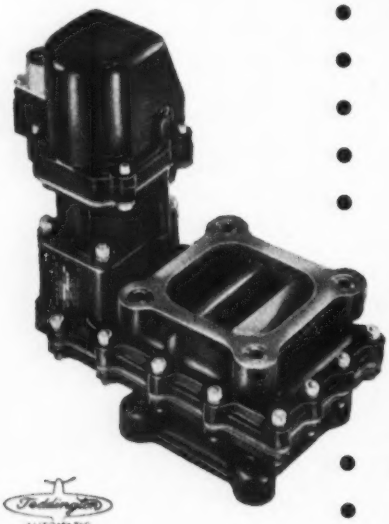
Teddington

HOT AIR VALVE WITH 3 in GATE



This is a general-purpose isolation valve for use in hot-air systems. It will work at temperatures up to 350° C. and against pressures up to 150 p.s.i. Under these conditions it provides a shut-off valve with a leak rate of less than 1 cu ft/min. It is available in forms to suit all installations and the high temperature integral actuator can be supplied to cover a range of speeds without change of physical dimensions.

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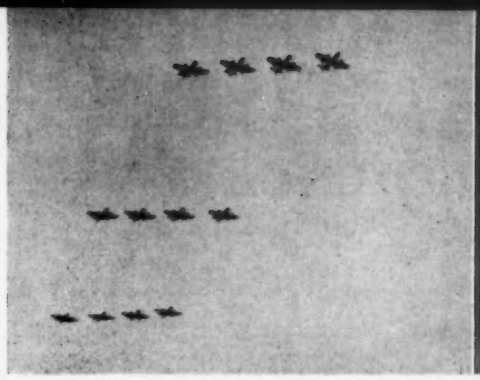


The R.A.F. on Show

LAST week we gave accounts of some representative displays organized at R.A.F. stations on the Saturday —R.A.F. At Home Day—of Battle of Britain Week. On this page are further pictures and brief descriptions—one of them from as far away as Kenya, for the occasion was not confined to R.A.F. stations at home.

IN SCOTLAND

MORE THAN 200 aircraft—half of them jets of various types —took part in the displays at Scottish R.A.F. stations; they were based at five airfields, which were open to the public—Turnhouse, Edinburgh; Leuchars, Fife; Dalcross, Inverness-shire; Dumfries; and West Freugh, Wigtownshire. Among the aircraft which attracted special interest was a Canberra, visiting Turnhouse, and a Naval Attacker, demonstrated at Leuchars.

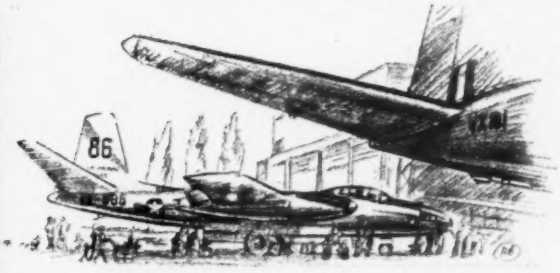
On the Sunday, thanksgiving services were held at the Tron Church, Glasgow, and at St. Giles Cathedral, Edinburgh.

A correspondent who visited the Turnhouse display writes that, although bad weather hampered the flying and caused a re-arrangement of the programme, the public were given an interesting afternoon. Meteors and Vampires of Nos. 603 (City of Edinburgh) and 612 (County of Aberdeen) Squadrons, R.Aux.A.F., flew past in close formation to open the proceedings, and a display by No. 666 A.O.P. Squadron (Perth) was likewise appreciated.

A Chipmunk pilot of Edinburgh University Air Squadron entertained the crowd with a fearsome "first solo," and another hair-raising show, this time of crazy flying, was put up by a Tiger Moth pilot. A close-formation display by four Meteors was good to watch, and among other programme items were a gliding demonstration, an attack on a dummy tank, individual displays by a Meteor and a Canberra and also a fly-past of the aircraft in the static show—two U.S.A.F. Sabres, Meteor F.8, Meteor N.F.11, Vampire N.F.10, a Transport Command Anson, Edinburgh U.A.S. Chipmunk T. mk 10, and two Tiger Moths, and a Vampire F.5 and an Oxford.

Exhibits in a large hangar included a recruiting display, a film-van showing Battle of Britain episodes and a L.A.A. unit of 2603 (County of Edinburgh) R.Aux.A.F.Regt. Squadron, who also gave a display on the airfield.

The B-45 Tornado sent by the U.S.A.F. to Benson—sketched from under the tail of the prototype Canberra P.R.3.



"Flight" photographs

(Top left) wing formation of Meteor 8s at Duxford. (Top right) Three Washingtons of Bomber Command pass over Tangmere. (Above) Part of the crowd round the static display at Tangmere.

AT CRANWELL

A LARGE CROWD witnessed the flying display and ground exhibition at Cranwell. The flying display was, naturally, the main attraction, and it involved a large and varied selection of aircraft. Two formation aerobatic teams consisting of Meteors and Sea Furies gave faultless exhibitions which drew well-deserved praise. Formation flying was demonstrated by Harvards and, in a lighter vein, spectators were asked to take part in a speed-judging competition, while a novel balloon-bursting episode was provided by a Chipmunk.

During the afternoon the airfield was visited by large formations of many types of aircraft from other stations, many of which had also provided aircraft for the static display, which was comprehensive in the extreme. Most of the training sections of the station were open to the public, giving them insight into modern aircrew training. Link trainers and voice recorders were all put to good use in raising funds for the R.A.F. Benevolent Fund—which was, of course, the main object of the day.

FROM KENYA

FORTY THOUSAND PEOPLE, including two-thirds of the European population of Nairobi and some thirty thousand Africans and Asians, trekked from Nairobi and surrounding towns to R.A.F. Station Eastleigh, Nairobi, to attend what undoubtedly was the greatest air display—in connection with Battle of Britain Week or any other occasion—ever held in M.E.A.F. Command.

Thousands from Nairobi and Eastleigh walked, bicycled, bussed, taxied, and went by car to the station gates, which were thrown open to the public for the first time since 1948. Many exhibits showing the work of the R.A.F., together with sideshows and other attractions, were visited by enthusiastic crowds.

In the flying display, held during the afternoon, a Canberra piloted by S/L. A. Tennant, D.F.C., gave a magnificent exhibition of flying, and an excellent show was also given by an aerobatic team of Vampires.

Another popular feature was aerobatic flying by two Harvards from Southern Rhodesia. An amazing exhibition by the pilots of these two vintage trainers, competing against Britain's most modern jets, won the admiration of the huge crowd.

The show was attended by the Air Officer Commanding, East Africa, Air Commodore C. T. Pankhurst and His Excellency the Acting Governor of Kenya, Mr. H. S. Potter.

CORRESPONDENCE

The Editor of "Flight" does not hold himself responsible for the views expressed by correspondents in these columns; the names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.

Supersonic Bangs

YOUR "Brief Note on Bangs" in the issue of September 12th left me still puzzled and not entirely convinced. I must admit, after reading your explanation, to sharing your expression of surprise that the bangs can reach window-shattering intensity. Furthermore, I think it is true to say that most bang-producing aircraft now in this country usually return to subsonic flight well above 20,000ft.

I have hitherto explained the bangs to myself (and perhaps too glibly to others) in a somewhat simpler manner. Existing aircraft presumably only exceed the speed of sound by a small margin, and in accelerating to this speed spend an appreciable time flying at just about the speed of sound. If an aircraft is diving at the speed of sound for, say, 5,000ft all the noise it makes during this time must reach, at the same moment, any point on a straight line that is a continuation of the flight-path. It seems reasonable that all the considerable noise made by a jet aircraft in a matter of, say, 15 seconds should, arriving simultaneously at one point, produce a bang. This explanation accounts for the directional nature of the phenomena and the double bang may be produced by the two periods of near-sonic flight when it is accelerating and then decelerating. The observer on the ground then hears the decelerating bang first, followed by the bang actually produced by the aircraft first (if you follow my Irish).

Shawford, Hants. D. R. H. DICKINSON.

[This accords with the theory advanced in an article on page 442 —ED.]

Display High-spot

NOT being one who is particularly moved to rhapsodize on aircraft and flying in general, I should like to take this opportunity to let myself go, and say that for sheer showmanship, the trio of Avro deltas flown at the S.B.A.C. Display had nothing to touch them. The superb positioning of the 698 with the 707s on each side as outriders was a wonderful presentation piece, and the handed rolls of the 707s while the "big un" flew straight on, put a real masterful finale to their display.

All those responsible for this bringing of the future so soon into the present day are to be sincerely congratulated, and Britons should be very proud. You ought to have heard the U.S. Air Force officers standing just behind me !

Birmingham, 2. PETER F. WRIGHT.

Naming the 698

MAY I suggest that the following list be considered in the selection of a name for the Avro 698 : Avalanche, Arrow, Aristocrat, Avalon.

Several Avro bombers have been named after cities, therefore Avalon would be suitable, as it was the ancient name for Glastonbury.

By the way, I went to R.A.F. Station Hornchurch on "Owners' Day" and heard a remark which I thought was rather amusing.

The U.S.A.F. Thunderjets were doing formation aerobatics when a young lady asked her escort why American fighters leave a trail of black smoke; and the young man said in a knowledgeable voice, for all to hear : "The reason is that the Americans use a fifty-mixture of paraffin and kerosine in their engines, but we only use paraffin in ours because it is cheaper."

For security reasons I was unable to say that the Americans use the older type of bicycle oil lamp with the wick turned up rather high.

Seriously, though, it is very encouraging to see such large crowds of people turning up to watch flying displays, especially when football is also "on." I believe we are fast becoming the most aviation-minded people in the world.

Cockfosters, Herts. NORMAN V. BRITTAIN.

NO doubt the Avro company will please itself in the matter; and no doubt the Air Ministry will do the same; none the less, one can get a little fun from playing with the idea of finding a name for the new Avro bomber. Even if one restricts oneself as in the past to the names of towns, there are quite a number of possibilities.

The *Oxford Atlas* offers us—too good to be true—two towns named "Delta." Unhappily, they are both in the United States, and our American friends will forgive us if we reject them in favour of an all-British name for this all-British achievement. On the other side of the globe we find "Triang," in Malaya—not very well known, perhaps, but how beautifully appropriate. "Three Points," on the Gold Coast, is unfortunately not a town but a cape, which perhaps rules it out. The same objection would apply to "Dart," even if Rolls-Royce had not already appropriated it, while neither "Dartford" nor "Dartmouth" is particularly apt. The front view of the great beast suggests that "Avonmouth" might be acceptable—though a possible change of engines in the future would rather upset things.

My own vote would unhesitatingly be given for "Alexandria." Firstly, it begins with A, and combines euphoniously with Avro; secondly, the name is basically Greek, which is appropriate to an aircraft shaped like a Greek letter; thirdly, it is named after a famous world-beater; fourthly, the name "Alexander" means "Defender of Mankind"; and fifthly, "Alexandria" is associated with what is historically the most important delta in the world. The only objection that I can see is the possibility that some ignorant Sassenachs may complain that Alexandria is not a British town. Let them say this on the banks of Clyde and see what answer they get !

Now what about some suggestions from other readers?

Horning, Norfolk. N. YOUNG,
Wing Commander (Ret.)

[Names so far suggested—by a member of *Flight* staff in a recent article—include Assegai and Albion, with Aurora and Argosy for a civil development.—ED.]

Farnborough Oracles

IN answer to Mr. Rattle's letter (*Flight*, September 19th), I think there may be quite a simple explanation for the naïveté of the two gentlemen of whom he speaks.

Although the Monday is generally known as "Technician's Day" at the Farnborough Show it is also the day upon which the employees of the R.A.E. are permitted to have a brief glance at the exhibition. The S.B.A.C. very kindly gives a certain number of complimentary tickets to the director of the establishment, "for services rendered," and these are distributed regardless of status or seniority to the R.A.E. employees. As the number of tickets works out at about one between six people, a relay system is devised by which each person may spend approximately one-and-a-half hours at the exhibition before handing his ticket to the next person.

Thus not only "boffins" and technical staff enter the sacred precincts, but clerks, labourers, switchboard operators, fitters—in fact people who, though interested in the show, might not know one end of a helicopter from the other.

I think this should be said in fairness to the directors of the S.B.A.C. and the R.A.E., who do *their* best to allocate the tickets fairly. (MISS) A. FREEMAN.

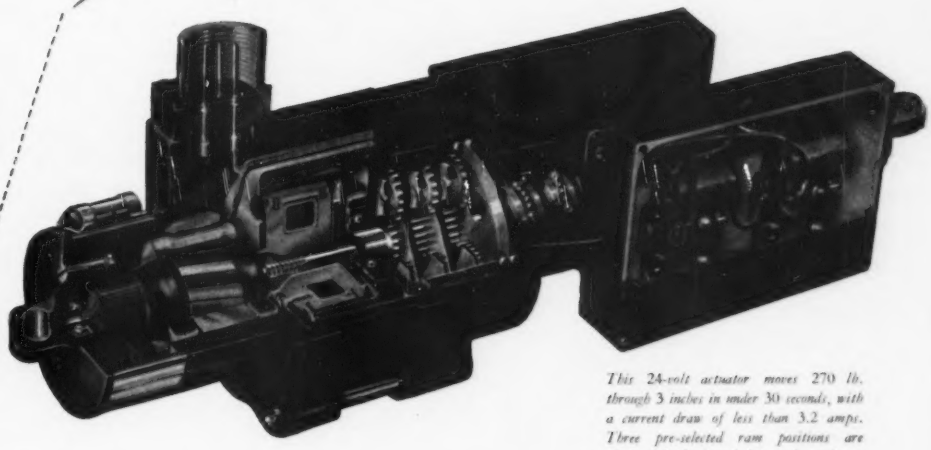
[We echo our correspondent's final sentiment.—ED.]

FORTHCOMING EVENTS

Oct.	3.	Helicopter Association: Brains Trust (Question Master, N. E. Rowe, C.B.E., F.R.Ae.S.).
Oct.	9.	Institute of Welding (Teeside Branch): Recent Development in the Welding of Aluminium Alloys," by E. J. Heeley, A. Met., F.I.M. (at Nottingham).
Oct.	13.	Women's Engineering Society: "Meteorology and the Engineer" (lecturer to be announced).
Oct.	15.	Aircraft Recognition Society: Second 1952-3 Meeting and contests.
Oct.	16.	Institute of Welding (South London Branch): "New Ideas on the Welding of Aluminium," by P. T. Houldcroft.
Oct.	17.	Institute of Navigation: Annual General Meeting, and Presidential Address by Rear Admiral A. Day, C.B., C.B.E., D.S.O.
Oct.	25.	S.L.A.E.: Film Show.
Oct.	28.	Aircraft Recognition Society (Plymouth Branch): Second 1952-3 Lecture Meeting and Recognition Contests.
Nov.	7.	Helicopter Association: "Operational Future of the Helicopter," by P. G. Masefield, M.A.(Eng.), F.R.Ae.S.
Nov.	8.	British Interplanetary Society: "Evolution of Life in the Universe," by Prof. J. D. Bernal, F.R.S.
Nov.	21.	Institute of Navigation: "The Vertical Reference in Navigation," by W. A. W. Fox and D. Barnett.
Nov.	25	Society of Instrument Technology: Symposium on "Control Valves." Papers by A. R. Aikman, B.Sc., H. R. Walton, B.Sc., A.M.I.Mech.E., B. W. Balls, B.Sc., A.M.I.Chem.E.
Nov.	29.	S.L.A.E.: "The Bristol Proteus Gas Turbine," by D. Dekkars.
Dec.	5.	Helicopter Association: "Simulation of Flight Loads, by Ground Tests," by M. J. Brennan, B.Sc., and R. Hafner.
Dec.	13.	British Interplanetary Society: "Guidance and Control of Missiles," by J. Humphries, B.Sc.(Eng.), A.M.I.Mech.E., A.F.R.Ae.S.

The Electrical Aspect

OF AUXILIARY POWER IN AIRCRAFT



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ROTAX have developed Linear Actuators of all sizes. These are in use on such outstanding aircraft as the de Havilland COMET, the Handley Page HERMES 4 and the Vickers VISCOUNT.

Electric actuation gives many advantages to the aircraft designer, including accuracy of control and movement, comparative lightness in weight, easy installation and long service life.

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CIVIL AVIATION

COMET-APPEAL

LAST week we learned from B.O.A.C. that every seat is booked on Comets leaving London for Johannesburg between now and mid-November. After that, there are "only a few odd seats" left on this service up to July next year—a booking record which may well be without parallel in air transport. The Comet service to Colombo is also booked solid up to mid-November. Load-factors on the Johannesburg service since its introduction on May 1st have averaged 79 per cent, enabling B.O.A.C. to operate its first jet service profitably despite the penalty of the heavy fuel reserves which caution at present demands.

The novelty of jet travel is, of course, largely responsible for the high load-factors: many passengers are willing to postpone a journey by weeks simply because the prospect of flying by Comet appeals to the imagination.

AERODROME OWNERS MEET

VISITS to the de Havilland factory and airfield at Hatfield and to London Airport were highspots of the two-day annual conference held last week by the Aerodrome Owners' Association. At Londonderry House, where the conference was centred, the Association's members inspected the latest types of traffic control equipment produced by International Aeradio, Ltd., and heard a talk by Mr. William Courtenay.

The visit to Hatfield, on September 24th, enabled delegates to see the progress made recently by the de Havilland aircraft, engine and propeller companies. Mr. Geoffrey Monro, a member of an architectural firm who have recently designed an impressive new Comet flight-shed, read a paper on *Buildings for Aircraft*.

On the following day, Sir John d'Albiac welcomed the conference to London Airport and gave an outline talk on the past, present and future of this massive terminal; the party then made a two-hour coach tour of the airport.

The conference does not involve any formal discussions, but is held to keep its members fully up-to-date on modern developments in aviation, and to enable them to exchange views. A photograph of the visit to London Airport appears on page 460.

LUTON'S ELEGANT TOWER

LUTON Airport's new control tower was officially opened by Mr. A. T. Lennox-Boyd, Minister of Transport and Civil Aviation and M.P. for Mid-Bedfordshire, on Wednesday, September 24th. The tower, of striking yet strictly functional design, commands a view of the entire airfield.

The Minister was welcomed by Alderman R. C. Oakley, chairman of the Airport Committee, who said that Luton was determined to develop its airport and make it a worthy one in the network of air services in the country.

Mr Lennox-Boyd said he was glad that a progressive municipality which believed in the future of its own airport was to be found near to his own constituency. He said that although present stringencies in materials made certain developments difficult, he was very pleased that the elegant new control tower had been built, and he hoped that there would soon be a flourishing airport for Luton, to help its trade with other parts of the world. The Minister went on to say that he hoped to forward private enterprise so that, together with State aid where it was needed, there could be harmony in the air. Congratulating Luton on its enterprise, he said that his Ministry could help in a number of ways. Alderman H. C. Janes, who was chairman of the Airport Committee last year, thanked the Minister for the encouragement his presence had given.

For a period before the opening ceremony guests were entertained by a flying display in which the Percival Provost and a Prince were demonstrated, and a B.E.A. helicopter was seen for a few minutes, having been diverted on its London-Birmingham run. A D.H. Comet took a few minutes off from development flying in the area to show its paces and Capt. Beaumont's conversation with the flying-control officer, Mr. P. T. Davies, was heard over the broadcast system.

LUTON TOWER: As reported below, this attractive new control tower at Luton Airport has been opened by the Minister of Civil Aviation.

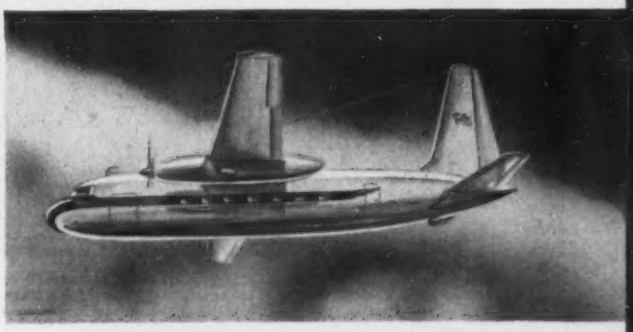
After the ceremony a York belonging to Eagle Aviation, Ltd., made several impressive low passes in front of the tower, and the Minister talked to the pilot, Capt. Harold Watkins, by R/T. On his inspection of the new tower Mr. Lennox-Boyd was accompanied by Dr. Charles Hill, M.P. for Luton, and Mr. Norman Cole, M.P. for South Beds.

Several other important projects are in mind for the development of the airport, and plans have been completed for the erection of additional hangars, for the laying of concrete runways, and the provision of full night-flying facilities. Reference was made to the layout and construction of the new control tower in *Flight* last week. Companies at present operating from Luton are Percival Aircraft, Ltd., D. Napier and Son, Ltd., Eagle Aviation, Ltd., and the English Electric Co., Ltd.

U.K.-AUSTRALIA DISCUSSIONS

THE partnership arrangements between B.O.A.C. and Qantas Empire Airways on the Kangaroo route were reviewed last week in discussions between Mr. A. T. Lennox-Boyd, Minister of Civil Aviation, and his Australian opposite number, Mr. H. L. Anthony, who is at present visiting European capitals. The Kangaroo service, which is operated by the two companies on a 50-50 basis, consists of six Constellation flights weekly in each direction between London and Sydney. This subject had been

(*continued on page 461*)



THE FRIENDSHIP, Fokker's projected DC-3 replacement, is illustrated for the first time by this artist's impression. Two versions of this 28/32-seat transport may be built—one with two Rolls-Royce Dart turboprops (as shown), the other with two Wright Cyclones.

CIVIL AVIATION . . .

B.E.A.'s ACCOUNTS, 1951-52

"A PERIOD of intense endeavour and substantial achievements combined, unfortunately, with some severe disappointments, leading to an increased deficit." This summary of British European Airways' fifth complete year of operations (the twelve-month period ended March 31st) introduces the Corporation's annual report and accounts, published last Tuesday. The deficit referred to is a net loss of £1,423,611, an increase of 45.4 per cent on the previous year's figure of £979,267. The news that (financially, at least) B.E.A. lost ground while B.O.A.C. advanced to its first clear profit is certainly disappointing. However, the two Corporations operate under very different circumstances and comparisons, if not obvious, would certainly be premature so soon after the publication of their respective accounts.

In the following table, B.E.A.'s financial results for the year under review are seen in relation to a considerable increase in traffic:—

	1951-52	1950-51	Variation (per cent)
Traffic revenue	£10,443,921	£8,674,681	+ 20.4
Operating revenue	£10,817,687	£8,998,821	+ 20.2
Expenditure	£12,241,298	£9,978,088	+ 22.7
Net loss	£1,423,611	£979,267	+ 45.4
Capacity ton-miles	56,698,000	52,938,100	+ 7.1
Load ton-miles	36,695,000	30,588,000	+ 20.0
Revenue load-factor	64.7%	57.8%	+ 12.1
Break-even load-factor	73.2%	64.4%	+ 13.7
Total cost per capacity ton-mile	51.8 pence	45.2 pence	+ 14.6
Traffic revenue per load ton-mile	68.3 pence	68.1 pence	+ 0.3

A further breakdown of traffic figures shows that during the year B.E.A.'s aircraft carried 1,135,579 passengers, 1,415 tons of excess baggage, 12,500 tons of freight and 6,489 tons of mail—percentage increases over the previous year's figures of, respectively, 20.9, 12.4, 24 and 23.6. Revenue hours flown totalled 153,579, broken down as follows: international routes, 108,367 hr; domestic routes, 44,410 hr; charter (excluding ambulance) 802 hr. At 46.8d per C.T.M., revenue on international services was almost twice the figure for domestic routes (24.0d). The average number of employees during the year was 7,978, or 13.2 per cent more than in 1950-51, and productivity per employee, as expressed in capacity ton-miles, went down by 5.4 per cent to 7,107. The average number of aircraft used by the corporation was 115.4, compared with 98.5 during the previous year, and the average utilization of each machine decreased by 6.1 per cent from 1,486 hours annually to 1,395 (or from 4.07 hours daily to 3.82).

In every month from February 1948 to October 1950, B.E.A. reduced the deficit or increased the profit—according to the time of year—by comparison with the corresponding month of the previous year. Good progress was, in fact, being made towards turning the loss into a profit; however, only five of the subsequent months showed a continuation of the favourable trend—which had been made possible by increased utilization of aircraft, development of traffic, better staff productivity and improved reliability of aircraft performance. Explaining why the loss curve resumed its upward climb, Lord Douglas of Kirtleside, chairman of B.E.A., commented that most of the factors were outside the airline's control. He outlined the main reasons as follows: (1) Delay in delivery of the Elizabethans, which completed only 116 revenue hours in the year under review. (2) The go-slow strike last July and August by over 500 members of the Association of Supervisory Staffs, Executives and Technicians; this "industrial dispute," said Lord Douglas, had cost at least £150,000. (3) An "inflationary" increase of £86,000 in expenditure on petrol. (4) The burden of domestic fuel tax (now 2s 6d/gall). (5) The introduction of the airways system and the consequent need to fly unproductive mileage; from B.E.A.'s viewpoint Paris was now 20 miles farther away. (6) A rise in the cost of aircraft and engine spares, food, stationary and other materials. (7) Pay-increases to nearly every grade of employee (totalling £600,000); these represented the greatest single cause of extra expenditure. (8) The restricted British £25 travel allowance, which is expected to have an even worse effect on this year's operations and will probably reduce budgeted revenue by 15 per cent.

Claiming that the time is ripe for review of all rates of mail-pay, the report states that if B.E.A. had been paid at the average rates obtaining in America in 1951 revenue would have been increased by some £1.8m, and that if B.E.A. had been paid at B.O.A.C. rates the increase would have amounted to some £375,000. It is also pointed out that no grant was made for the Scottish social services, whereas Air France and S.A.S., which declared profits for 1951, both received revenue payments for domestic social services.

Other main points in the report can be summarized briefly as follows. *Aircraft fleet:* at March 31st, this consisted of 49 Vikings, 6 Elizabethans, 33 Pionairs, 5 Dakotas awaiting conversion, 10 Dakota freighters, 2 Dart-Dakota freighters, 18 Islanders (Rapides), 1 Bristol Freighter and 6 helicopters; orders had been placed for 21 Elizabethans, 20 Viscounts (with an order for six more under negotiation), and 2 Bristol 171 helicopters. Vikings carried nearly 63 per cent of the total traffic during the year, with Pionairs or Dakotas taking most of the remainder. *Flight operations:* some 116,200 take-offs and landings had been made during the year without serious accident. Total number of flying staff stood at 1,085 on March 31st; of these, 289 were captains, whose 1951-52 flying hours averaged 673. Although no international decision had been taken on short-range navigational aids for Europe, B.E.A. had decided to adopt the Decca system. All aircraft except Rapides were to be fitted with I.L.S. Regularity, *i.e.*, percentage of scheduled services achieved, had averaged 95.2 per cent over the year, and of these services 76.6 per cent had arrived within 15 minutes of schedule. Flight simulators for Elizabethan and Discovery (Viscount) crew-training were due for delivery next year. *Helicopter operations:* the helicopter experimental unit had made 1,188 flights, totalling 797 flying hours. Its net cost was £86,696, of which £80,665 was chargeable to the M.C.A. and M.O.S. on an experimental contract. *London terminal:* Kensington Air Station, which had handled over a million passengers, was "busting at the seams," after prolonged negotiations with the L.C.C., the Corporation had acquired the Waterloo Gate at the South Bank site, which would come into operation as the new London terminal next spring. *Subsidiary and associated companies* achieved the following results in 1951: Gibraltar Airways, £2,492 deficit; Aer Lingus, £74,205 profit; Alitalia, £800 loss; Cyprus Airways, £1,791 loss. *The future:* the new aircraft, though expensive in their initial stages would bring B.E.A. into a profitable state. The report could not forecast an improvement in the financial position during 1952-53. Nevertheless, it was hoped that the tide would turn before the end of that year.

INTERESTED PARTY: AERODROME OWNERS AT L.A.P.

"Flight" photograph

A visit to London Airport was one of the features of the two-day conference held last week by the Aerodrome Owners' Association; members of the party are pictured here during their inspection of the new B.E.A. maintenance base. Full members of the Association represent the majority of commercial and municipal airports in this country, and the associate members are closely connected with or interested in civil aviation.

Do you know your airfields?

27

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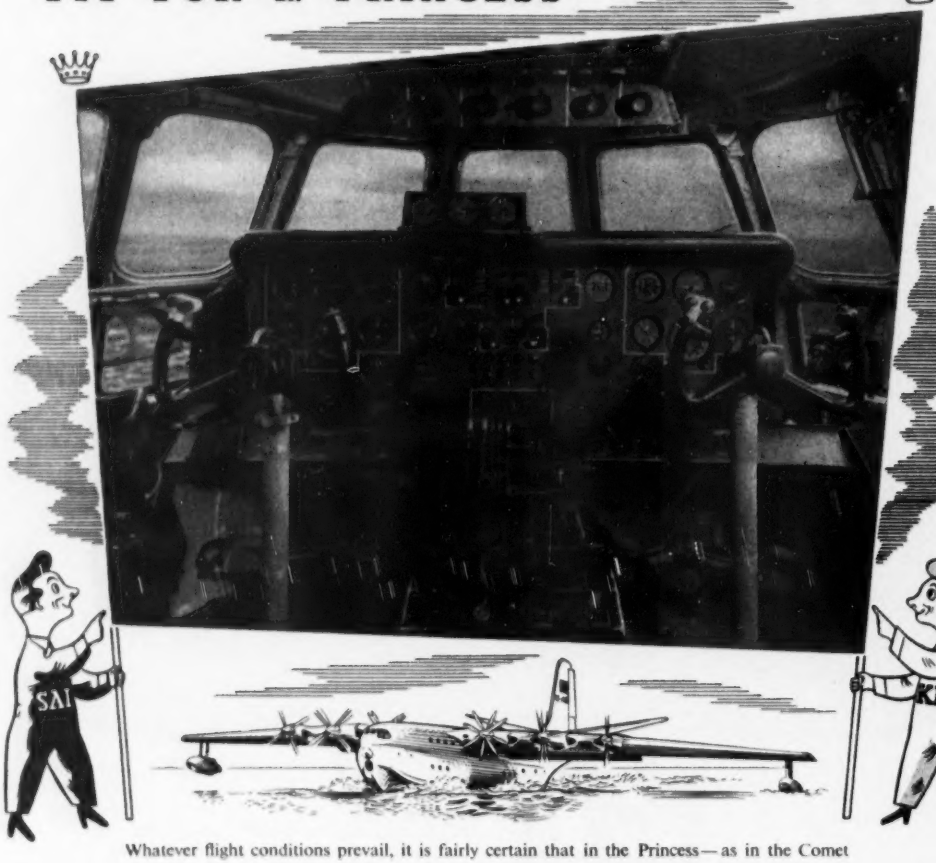
FIT FOR A PRINCESS



Whatever flight conditions prevail, it is fairly certain that in the Princess—as in the Comet —there will be a Smiths, Kelvin Hughes or Waymouth instrument to register them. This giant aircraft relies on numerous instruments supplied by the Smiths Group covering flight and engine performance, navigation, cabin pressure and fuel consumption.

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CIVIL AVIATION . . .

(continued from page 459)

covered by preliminary discussions in Canberra and Melbourne, as had the operations of the tripartite companies, British Commonwealth Pacific Air Lines and Tasman Empire Airways, in which interests are held by Great Britain, Australia and New Zealand (a proposal to merge Qantas and Tasman is reported to have been on the agenda). Since no New Zealand minister was able to attend the London talks, these were concerned mainly with the B.O.A.C.-Q.E.A. partnership and other civil aviation matters of mutual interest to the two countries.

S.A.S. PLAN NORTHERN-ROUTE SERVICES

WRITTEN by Einar Pedersen, a navigator of Scandinavian Airlines System, an article in *Flight* of August 8th discussed the potentialities of the polar route for commercial aircraft flying between Europe and Canada, the east coast of North America and the Far East. It was pointed out, for example, that an airliner could fly from Stockholm to Tokyo *via* Bodo, Thule, Anchorage and Shemya in 30 hr 15 min, some 10 hr less than by the conventional route *via* Rome and Bangkok. Now S.A.S. have announced their preliminary plans to take advantage of this time-saving route. Scheduled services from Los Angeles to Sweden *via* San Francisco, Seattle, Vancouver and Thule will, it is hoped, be inaugurated within the next year—perhaps as early as the spring of 1953. Valuable operating experience should be gained in November, when two of the company's new DC-6Bs are due to be ferried from California to Scandinavia by way of the Arctic.

PROVENCE ON TRIAL

GOOD progress is reported by Air France with operational trials of the first of its 12 double-decked Breguet 763 Provence passenger/freight aircraft. Tests began with landings at principal airports in France and North Africa, and since August 26th the aircraft has been carrying cargo on the Paris-Algiers and Paris-Casablanca routes. Utilization, which reached 40 hours in the first week, will gradually be increased as the aircraft starts to operate on longer routes. Flights to French West and Equatorial Africa will continue until December 1952, when the Provence is expected to receive its final C. of A. for passenger-carrying. Already, it is reported, the trials have shown performance in excess of expectations, including a cruising speed at mean weight of 227 m.p.h., maximum cruising speed of 240 m.p.h., and range at full load of 1,250 miles.

B.O.A.C.'S REPORT: A POSTSCRIPT

AN interesting postscript to last week's B.O.A.C. report for the year 1951/52 was formed by some remarks made by Sir Miles Thomas at a conference following publication of the report. Sir Miles had stated that B.O.A.C.'s profit was small in relation to the uncertainties of international airline operation. It would not be easy to continue to make a profit. This point was emphasized by his statement that there was a falling-off in mail revenue, that the fuel strike had cost the Corporation £250,000 and that, in general, improvement was not as fast as it had been last year. On the subject of freight operations he said that the Corporation would like to do regular cargo flights across the North Atlantic, and they were actively studying the prospects. However, economy depended on equipment, and successful freight operators were using only the latest aircraft. B.O.A.C. were pressing for a freighter version of the Britannia. Sir Miles implied that most of the all-freight overseas routes were likely to be operated by the independents, although the Corporation would exploit to the full the possibilities of carrying freight as "fill up" on the regular passenger services.

Although the initial break-even load factor for the Comet was slightly higher than for the rest of the Corporation's types, this was only to be expected in the early stages. No decision as to the use of Comet IIs on the North Atlantic route could be made until they had acquired the prototype for upper-air exploration trials over the route. If the results were favourable their plan would be to fly Comet services direct from New York to London and from London to New York with one stop—at Gander. The aircraft was likely to begin its working life on the South American routes. The first Comet I service to Singapore would start on October 14th and the inauguration of the London-Tokyo service was scheduled for the spring of 1953.

Sir Miles also revealed that the de Havilland company had received B.O.A.C.'s letter of intent for Comet IIIs, although he was not yet prepared to disclose the number of aircraft involved. If Pan American Airways decided to buy Comet IIIs—and Sir Miles appeared to think this was now very likely—the Corporation would give its competitor part of its "place in the queue." Although B.O.A.C.'s self-imposed rôle as "salesman" for the Comet is in line with national policy, it does not conflict with the Corporation's own interest in accelerating world-wide acceptance of jet transports.

An indication of the success of B.O.A.C.'s low-fare North Atlantic services is the fact, announced last Monday, that the Corporation had acquired two more Constellations—68-seat Model O49s, bought from Pan American.

CHARTER NOTES

DURING the week ended September 28th, the British independent air transport operators completed 88 commercial flights in addition to their regular trooping work. Although some operators were rather less busy than usual the overall result of the week's flying was a 10 per cent increase in the recent average mileage. Sixty thousand miles of freight flying and 32,500 miles of passenger work were completed; the increase is accounted for mainly by refugee trips from Berlin to Hanover, and by a general tendency for charter flights to be flown over longer distances. Although freight *mileage* has recently remained constant the amount of goods carried has fallen again to 360 tons; simultaneously, passenger traffic has once more risen to more than 1,000, with mileage likewise increasing by about 10,000 miles over the previous week. Because of a copying error on the part of this contributor some very wishful but incorrect passenger-mile and ton-mile figures were quoted last week. These should have read 155,000 ton-miles and 505,000 passenger-miles (45,800 ton-miles); this week the freight ton-miles figure is 136,000.

The aircraft in greatest use this week was the Dakota, with 42,000 miles to its credit. Avro Yorks flew 26,500 miles and Bristol Freighters 24,000 miles. The probable resultant revenue was, at £40,000, the highest for some time; flying hours, at 573, were also higher and exactly 50 per cent of them logged were by Dakotas. One of the more urgent charters was a dash to Marseilles, by a Dakota of Eagle Aviation, carrying a new ship's boiler to a disabled vessel. An Eagle Dakota flew to Geneva and returned with 24 passengers and a York returned from its helicopter delivery trip to Khartoum. That city was the destination of 42 passengers flown out from England in Dakota aircraft of Air Transport (Charter) (C.I.) Ltd., manned by Airwork crews and under sub-charter to Airwork.

Bristol 170s on the "minor airlift" completed 35 round trips from Berlin to Hamburg, Hanover and Dusseldorf; about 10 of these were passenger flights. In four of these round trips Silver City Freighters carried 16 racing cars between Hamburg and Berlin. Other Silver City work included two freight trips to North Africa and a return horse flight between Le Bourget and Blackbushe. The usual load of 11 tons of cheese was ferried across the Channel from Lympne to Le Touquet, as were seven tons of periodicals. Air Charter's Yorks also completed 35 round trips from Berlin, many of these being passenger flights.

Scottish Airlines completed one return Dakota trip to Dukhan with freight for the Iraq Petroleum Company and took 28 passengers to and from Innsbruck and Salzburg.

A Skyways York returned with freight from Bangkok but heavy trooping work prevented this company from undertaking commercial work. B.K.S. Aero Charter brought back a Dakota from Johannesburg with a load of freight and sent out a similar aircraft to the same destination, with 29 passengers, for Tropic Airways. Another B.K.S. Dakota flight brought 24 passengers back from Geneva. There may be a falling-off of normal business in the next few days, but this should be counter-balanced by a very substantial rise in the amount of passenger flying from Berlin.

HELICOPTERS FOR HORTICULTURISTS

IN a paper ("The State of Horticulture") read before the Canterbury Branch of the National Farmers' Union on September 17th, Mr. John Baker White, M.P., had some interesting things to say about the possibilities of the helicopter for the transport of market produce.

"We all know too well," he told his audience, "the problems of transport, and the problem that arises from the fact that our areas of horticultural production are centred largely in the south-east, south and west of the country (and in the case of the Channel Islands farther south still), whereas with the exception of the London area the great consuming centres are in the North and Midlands. It also happens that it is more economic for the foreigners to send their produce to London and the southern markets. The situation, therefore, quite often arises that there is a glut of produce in the London market, with bad returns to the growers, when the produce of which there is a glut is not available in the Lancashire, Scottish, North-East Coast and Yorkshire markets at all. This often happens in the case of early strawberries, cherries, broccoli, peas and beans—the very crops that should give the best returns to the grower.

"I believe that we must look somewhere else, other than road or rail, for a solution to this problem. The helicopter is now being developed as a commercial and military aircraft at a tremendously high rate. New and bigger designs are being manufactured in this

CIVIL AVIATION . . .

country, and the Americans now have a helicopter that will lift a load up to the size and weight of a Sherman tank. In contrast to other aircraft, helicopters do not require prepared landing-fields. The largest British helicopter at present in service would carry a load of about 900 lb of freight. That weight of, let us say, early strawberries, picked up at Titchfield or some other centre in the Hampshire strawberry area, would, I believe, be a sound economic proposition delivered in the best possible condition a few hours later in Manchester, Birmingham or Leeds. I think the same argument would apply for early cherries, early vegetables and tomatoes grown under cloches and glass, and perhaps even for early Cornish broccoli. The new Bristol 173 helicopter, on show at Farnborough recently, can carry a 1,500 lb load.

"I am proposing to make further inquiries into the whole economic aspect of this problem, but I do think it is one to which all those engaged in progressive horticulture should direct their most serious attention. I also believe that where airfields are available more could be done by using Dakota aircraft for internal carriage of fruit and vegetables. If it is economic for the French to fly fruit and vegetables here it is surely economic for us to consider doing the same thing. Half the battle in getting good prices for produce," said Mr. White, in concluding this section of his lecture, "is to get that produce into the shops in the best possible condition and sell in the shortest possible space of time. I think also that the Government and the wholesale and retail federations should get together to try to ensure that more of the foreign produce directly competitive with our own early crops should go to the northern markets."

BREVITIES

THE new service between Auckland, N.Z., and Western Samoa will be opened by Tasman Empire Airways on October 14th. It will be operated thrice monthly with Solent flying-boats, which will make a night-stop at Suva, Fiji.

* * *

Extension work at Rongotai Airport, Wellington, N.Z., is now in progress. The scheme, which is expected to cost over £3m, includes the building of a 6,000ft main runway.

* * *

Prince Bernhard of the Netherlands will, it is reported, take part in the inaugural flight of a new K.L.M. weekly service between Amsterdam and Mexico City. Due to open on October 27th, the service will be operated with DC-6s flying *via* Montreal and Monterray in 30 hours.

* * *

The results of A.N.A.'s famous "Air Beef" operation this year are said to be the best experienced since the cattle airlift began in 1949. The number of cattle killed at Glenroy and flown by Bristol Freighter to Wyndham this season is expected to total 5,300, an increase of over 1,200 on last year's figure.

* * *

Greatly increased operating costs are blamed for the loss of £76,000—twice the previous year's deficit—suffered by East African Airways during 1951. The company's revenue rose by 29 per cent during 1951, and the number of passengers carried (64,000) was 31 per cent greater than in 1950.

* * *

During the six-month period ended June, 1952, aircraft of Central African Airways flew 21,057,823 revenue passenger-miles, 35 per cent more than in the corresponding period last year. The number of passengers carried was 43,539, an increase of 38 per cent, while mail and freight figures showed increases of 16 and 24 per cent.

* * *

During August, B.E.A. carried 204,800 passengers—a record figure which almost approaches the total transported in the first year of B.E.A.'s operations, 1946-47. The Corporation is the first European airline to exceed 200,000 passengers in a month. Of the total, 95,000 flew on B.E.A.'s international routes and over half the remainder were carried on the Channel Islands services.

* * *

Japan has applied for membership of I.C.A.O. under the terms of the Peace Treaty signed in San Francisco a year ago. The application, which has been submitted to the United Nations General Assembly which begins on October 14th, will also have to be approved by the I.C.A.O. Assembly; if it is successful, Japan will become the 58th nation to join the organization.

* * *

Mr. Robert Watson, who was until recently industrial relations officer to the Road Haulage Executive, took up his new duties as chief personnel officer of British European Airways on October 1st. Mr. Watson, who is 47, has had extensive experience in personnel management both in Britain and in America during the past 24 years.

* * *

Qantas Empire Airways have received permission to make an additional stop—at Melbourne—in each direction on their fortnightly service from Sydney to Johannesburg. The Constellations used on the service will leave Sydney at 2030 hr on alternate Mondays, landing at Melbourne some two hours later and taking off for Johannesburg, *via* Perth, the Cocos and Mauritius, at 0001 hr.

* * *

The seventh General Assembly of the International Union of official travel organizations is to be held in Naples from October 7th to 12th. Restrictions on international travel will be a major subject for discussion between delegates from the 46 member-countries, including Sir Alexander Maxwell and Mr. J. G. Bridges, respectively chairman and director-general of the British Travel and Holidays Association.

* * *

Cambrian Air Services report that August was the third consecutive month in which records for air travel between Cardiff and the Channel Islands have been broken. The company's Rapides carried 1,370 passengers on 234 flights between Cardiff and Jersey, of which 88 were routed *via* Guernsey. The load-factor for the month was 83.5 per cent. Since the service was inaugurated in May, 1949, the Rapides have flown over half a million miles, carrying 11,768 passengers.

* * *

The allegation that, "because of improper storage," Government surplus engines and other aviation equipment offered for sale nowadays are "invariably unserviceable" is contained in a recent A.R.B. notice to licensed aircraft engineers and owners of civil aircraft. If such equipment has been stored or unused for more than six months since manufacture or complete overhaul, it must be completely dismantled, overhauled and tested, states the notice. Inspection of R.F.D. life-jackets is the subject of another A.R.B. notice, No. 39.

* * *

"Air Cargo Teams with Air Logistics" is to be the theme of a series of lectures and discussions on December 1st at the Hotel Statler, New York, forming the fourth annual Air Cargo Day of the American Society of Mechanical Engineers. Mr. L. R. Hackney of Lockheed will act as chairman, and Mr. C. D. Brell, operations vice-president of Seaboard and Western Airlines, will be vice-chairman. The only European speaker will be Mr. De Boer of K.L.M., who will read a paper entitled *Air Freight Development in Europe*.

* * *

The French Colonial operators U.A.T. have recently been conducting trials in Equatorial Africa with a turbomeca Palas auxiliary jet unit fitted to one of their DC-3s. A Dakota Aigle-Azur was also fitted with a Palas recently and two of these 250-lb-thrust units have been installed in a Curtiss Commando operated by a Brazilian company. The Palas is offered as a complete power-boost unit by the S.N.C.A.S.O. organization; British Commonwealth sales are handled by Aerocontacts, Ltd., of Gatwick.

ADMIRAL is the class-name given by B.E.A. to their Vikings modified to carry 32-38 passengers, as shown here for the first time. The Corporation is using these aircraft on the new cheap-fare services between London and Paris, which opened on Wednesday.

SERVICE AVIATION

Royal Air Force and Naval Aviation News

AEROBATIC PLAN: F/L. Byrne, of Central Flying School, inverts his Harvard before the camera prior to his solo aerobati: shows at South Cerne/ and Abingdon on Ba.tl.: of Britain day.

R.A.F. in U.S. Bombing Contest

ON Sunday last two Washingtons of No. 3 Group and two Lincolns of No. 1 Group left Prestwick for America to take part in the U.S.A.F. Strategic Air Command bombing competition, which will be held at Davis-Monthan air base, Tucson, Arizona, from October 13th to 18th.

They are competing at the invitation of General Curtis LeMay. It will be remembered that aircraft of the 7th Air Division, Strategic Air Command, took part in the R.A.F. Laurence Minot Trophy competition last July and were placed second.

The R.A.F. team is commanded by W/C. H. N. G. Wheeler, D.S.O., O.B.E., D.F.C., who is wing commander flying at Marham. S/L. T. Helfer, D.F.C., from R.A.F. Hemswell, commands the Lincolns. Captains of the Washingtons are: S/L. J. R. Denny, M.B.E., D.F.C., and F/L. N. R. L. Bristow. The Lincoln captains are Sgt. J. H. Waterman and K. N. Marwood.

Canadair Sabres for R.A.F.

THE Canadian Defence Minister has announced that Canada will begin to ship Sabre jet fighters to Great Britain during November. These machines, produced by Canadair, Ltd., will probably be essentially similar to the F-86E* variant, which now equips squadrons of the R.C.A.F. based in this country. It is likely that some of the first R.A.F. Sabres will be issued to squadrons of the 2nd A.T.A.F.

Ice-cap Rescues

THE twelve men forming the aircrew of the R.A.F. Hastings which force-landed on the 8,000ft ice-cap while dropping supplies to a forward camp of the British North Greenland Expedition, have now all been rescued.

On September 23rd came the news that three slightly injured cases, Major D. S. Barker-Simpson, F/S. F. Burke and Capt. Stover, U.S.A.F., had been flown out by a Grumman Albatross operating from the American base at Thule.

To rescue the remainder, a Dakota fitted with skis and piloted by Capt. F. O. Burnett, U.S.A.F., landed two days later at the scene of the accident and stayed on the ice-cap for an hour and a half. The nine men taken off by the Dakota were: F/L. M. A. Clancy (pilot), F/Ls. E. K. Adair and R. E. Michie, F/O. L. Richardson, F/Eng. R. R. Mosley, F/S. J. Boyd, L/Cpls. R. Hussey and B. Yates and Pte. G. Jones.

The operation was carried out under the direction of Colonel Bernt Balchen, U.S.A.F., the famous polar pilot. The Dakota was assisted by two other aircraft, one providing navigational assistance and the other acting as a direction guide halfway between the ice-cap and Thule.

Thanking the Americans for their aid in the rescue, Marshal of the Royal Air Force Sir John Slessor sent the following message to General Vandenburg, Chief of Staff U.S.A.F. "I am most grateful for your whole-hearted co-operation in the rescue of personnel marooned on Greenland ice-cap after Hastings forced landing. All here are much relieved at the news of the successful air rescue and I would particularly like to thank the Commanding General, North-East Air Command, and the 6th Air Rescue Squadron for making this possible."

Britannia Shield

TOMORROW, at a ceremony at R.A.F. Station, Uxbridge, Lord De L'Isle and Dudley will welcome over 150 competitors for this year's Britannia Trophy Competition. The nations represented will include Belgium, Gt. Britain, Holland, Norway and the United States.

The competition comprises an annual series of sporting contests between service teams of Allied Nations, for a perpetual challenge trophy, made from oak salvaged from the ruins of bomb damaged Guildhall in London. All profits from the competition are devoted to R.A.F. charities.

ON THE ICE-CAP: "Greenland" is surely a misnomer for the snow-covered area where the Hastings force-landed. This photograph was taken in a temperature of minus 17 deg C before tents were erected to protect the crew.

Farms and Gardens

PRIZEWINNERS in the R.A.F. Horticultural Show, held at the R.H.S. New Hall, Westminster, last Tuesday and Wednesday, received their awards from Lady Slessor.

The Unit Farms and Gardens Competition was won by St. Eval, Cornwall with Boscombe Down, Wiltshire, and Lindholme, Yorkshire, tying for second place. Hullavington, Wiltshire, came fourth.

R.Aux.A.F. Coronation Ball

ARRANGEMENTS have already been finalized for a Royal Auxiliary Air Force Coronation ball to be held on Friday, May 29th, next year, at the Savoy Hotel, London. Tickets are 45s each. It is expected that a number of distinguished honorary air commodores and R.A.F. officers will attend.

Past members of the A.A.F. and R.Aux.A.F. will all be welcome, but they should obtain their tickets through the units with which they served because, should requests exceed 500, a ballot may have to be held.

The arrangements are in the hands of a committee, of which F/L. R. G. Shillingford is chairman. F/O. P. F. Johnson, W.R.Aux.A.F. is secretary and all communications should be addressed to her at Woodside, South Ascot, Berkshire.

R.N.V.R. Air Divisions

OFFICIAL titles have now been approved for the R.N.V.R. Air Divisions, formed in June of this year at four Naval air stations to facilitate the rapid expansion in an emergency of the air branch of the Royal Naval Volunteer Reserve. In future, they will be known as: *The Scottish Air Division*, based at Donibristle, Fifeshire, and commanded by Cdr. (A) J. D. Murricane, M.B.E., D.S.C., R.N.V.R.; *The Northern Air Division* at

SERVICE AVIATION . . .

Stretton, Lancashire, and commanded by Cdr. (A) R. I. Gilchrist, M.B.E., R.N.V.R.; *The Southern Air Division*, at Culham, Berkshire, and commanded by Cdr. (A) G. McC. Rutherford, M.B.E., D.S.C., R.N.V.R.; and *The Channel Air Division*, at Ford, Sussex, and commanded by Cdr. (A) N. A. Bovey, D.S.C., R.N.V.R.

New C.O. for No. 1831 Squadron

SUCCEEDING Lt. Cdr. K. H. Tickle, R.N.V.R., who now commands No. 1841 Squadron, Lt. Cdr. W. A. Storey, R.N.V.R., has taken over the command of No. 1831 Squadron at Stretton, Lancashire.

Lt. Cdr. Storey has been with No. 1831 since 1947 and during the war flew Wildcats in No. 853 Squadron, operating from the escort carrier H.M.S. *Queen*.

R.N.Z.A.F. in Middle East

THE New Zealand Chief of the Air Staff, A.V-M. D. V. Carnegie, has said that when No. 14 Squadron R.N.Z.A.F. has completed its tour of duty in the Middle East it will be relieved by No. 75 Squadron.

It is intended that No. 75 will take over the Vampires of No. 14 in place of their own fighter-bomber Mosquitoes. To this end they will post selected pilots and ground crews for Vampire training with No. 14 Squadron.

R.A.F.A. H.Q. Opened

THE new headquarters of the High Wycombe branch of the Royal Air Forces Association were officially opened recently by Air Chief Marshal Sir Norman Bottomley, who was accompanied by Lady Bottomley.

During the ceremony the branch chairman, Mr. G. B. Lees, presented Sir Norman with a silver tankard as a memento of the occasion.

R.Aux.A.F. Appointment

THE new commanding officer of No. 500 (County of Kent) Squadron, R.Aux.A.F., is S/L. D. de Villiers. He will succeed S/L. H. C. Kennard.

S/L. de Villiers served with Nos. 68 and 608 Squadrons in 1942 before going to the Middle East, where he spent more than 12 months with No. 252 Squadron. Returning to Britain at the end of 1943, he had a short spell of duty with No. 288 Squadron before joining de Havillands as a test pilot. He has been with No. 500 Squadron since 1948.

No. 2600 at Biggin Hill

IN order that the "guns" may co-operate with the aircraft for training, No. 2600 (City of London) L.A.A. Squadron has joined its parent squadron, No. 600, at Biggin Hill for week-end training. No. 2600 is commanded by S/L. A. G. Collings, and the Queen Mother is the unit's Honorary Air Commodore.

This brings the number of R.Aux.A.F. units at Biggin Hill up to four; those in addition to Nos. 600 and 2600 are No. 615 (County of Surrey) Squadron and No. 3604 Fighter Control Unit.

NEW ZEALAND CELEBRATION: Over 300 aircrew and ex-aircrew members were present at the Auckland Brevet Club's Battle of Britain dinner. Air Chief Marshal Sir Keith Park (left) is chatting with A.V-M. D. V. Carnegie (right). In the centre is F/L. A. W. Robertson.

NO TRICORN: Lt. Macdonald, R.N., of No. 803 Squadron, wearing the new naval "Lombard" flying helmet. No. 803 have Attackers.

Henlow Church Windows

FUNDS are being raised to provide stained-glass windows for the station church at Henlow. S/L. H. W. R. Cullen, C. of E. chaplain on the station, states that two windows, which will include the crests of two commands, have already been provided by a private collection among the officers. These are to be unveiled and dedicated by Canon L. Wright, Chaplain-in-Chief to the R.A.F., next month. It is hoped that the other seven windows, presented by member-firms of the Society of British Aircraft Constructors, will be installed by that time.

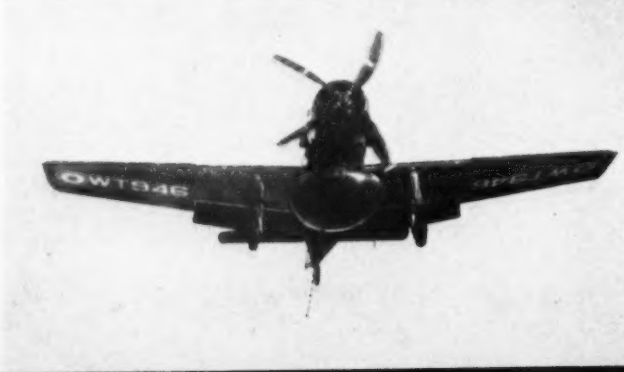
Reunions

THE annual "Evening of Reminiscences" of the R.A.F. Movements Organization will be held at the Palmerston Restaurant, Bishopsgate, London, on October 11th. Tickets (12s 6d) and further details from Mr. H. G. Rae, 11 Preston Close, Strawberry Hill, Twickenham, Middlesex.

The fifth annual reunion of No. 166 Squadron is to be held in London on October 18th. Further information and tickets (12s) may be obtained from F/L. F. C. Tighe, 31 Mayo Road, Sherwood Rise, Nottingham.

The Peacock, Maiden Lane, Strand, London, W.C.2, at 7 p.m. on Saturday, October 25th, is the venue for No. 136 Squadron's reunion. Tickets (10s) are available from S/L. V. K. Jacobs, c/o R. W. Cross, 35, Carlton Crescent, Southampton, Hampshire.

M.R.E.S. officers' fourth reunion, to be held in London on Saturday, December 6th, will include a show. Organization is in the hands of S/L. P. E. Laughton-Bramley, M.B.E., R.A.F. Officers' Malcolm Club, 24/26 Cadogan Gardens, S.W.3.



BACK TO THE EYRIE: A Skyraider approaches the flight-deck of H.M.S. "Eagle" during exercise "Mainbrace."

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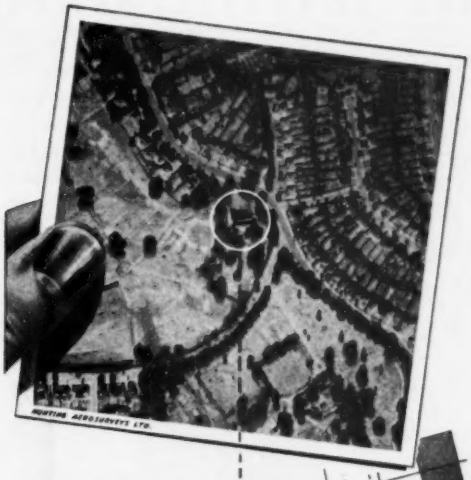

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PUBLIC ANNOUNCEMENTS

AIR TRANSPORT ADVISORY COUNCIL

THE Air Transport Advisory Council give notice that they have received the under-mentioned applications to operate scheduled air services:—

Application No. 38. From Lancashire Aviation (Aviation) Ltd., of Elmdon Airport, Birmingham, for a U.K. internal service for the carriage of passengers between Birmingham (Elmdon) and Jersey (C.I.) with intermediate traffic stops at Guernsey (C.I.) at an initial frequency of from one to two services on Saturdays with additional services as required, during the period from October 4th, 1952 to October 3rd, 1959.

Application No. 39 from Starways, Ltd., of Speke Airport, Liverpool, for a normal scheduled seasonal service with Dakota aircraft for the carriage of passengers, supplementary freight and mail between West Hartlepool (Greatham) and Hamburg at a frequency of from two to three services weekly with additional services as required, during the period from June 5th, 1953 to September 11th, 1956.

From Airlines (Jersey), Ltd., of 4, The Parade, St. Helier, Jersey, Channel Islands:

Application No. 40. For a normal scheduled service with DH.89A and D.H. Heron aircraft for the carriage of passengers, supplementary freight and mail between London (Gatwick) and Brest (Guipavas) with intermediate traffic stops at Southampton, Alderney, Guernsey, Jersey, St. Brieuc and Lannion at an initial frequency of from four to 84 services weekly, during the period from April 1st, 1953 to March 31st, 1963.

Application No. 41. For a normal scheduled service with DH. 89A and D.H Heron aircraft for the carriage of passengers, supplementary freight and mail between Manchester (Ringway) and La Baule (Escoublac) with intermediate traffic stops at Coventry, Bournemouth, Guernsey, Jersey, Dinard and Rennes at an initial frequency of four to 84 services weekly during the period from April 1st, 1953 to March 31st, 1963.

Application No. 42. For a Normal Scheduled service with DH. 89A and DH. Heron aircraft for the carriage of passengers, supplementary freight and mail between Exeter (Honiton Clyst) and Brussels with intermediate traffic stops at Guernsey, Jersey, Caen and Paris at a frequency of 14 to 27 services weekly during the period from April 1st, 1953 to March 31st, 1963.

From Airwork Ltd., of 15, Chesterfield Street, London, W.1.:

Application No. 43. For a Colonial coach service with Viking (VC1) aircraft for the carriage of passengers and supplementary freight between London (Blackbushe) and Salisbury (Belvedere) only at an initial frequency of from one to two services weekly, during the period from November 1st, 1952 to October 31st, 1959.

Application No. 44. For a normal scheduled service with Hermes aircraft for the carriage of passengers and supplementary freight between London (Blackbushe) and Livingstone (N. Rhodesia) at an initial frequency of from one to two services weekly, during the period from December 1st, 1952 to November 30th, 1959.

From Don Everall (Aviation), Ltd., of Elmdon Airport, Birmingham:

Application No. 45. For a U.K. internal service with DH. 89A aircraft for the carriage of passengers, supplementary freight and mail between Birmingham (Elmdon) and Newcastle (Woolsington) with intermediate traffic stops at Leicester and Nottingham at an initial frequency of three services weekly (additional as required) during the period from January 1st, 1953 to December 31st, 1959.

Application No. 46. For a U.K. internal seasonal service with DH. 89A aircraft for the carriage of passengers between Wolverhampton and Isle of Man (Ronaldsway) at an initial frequency of one service Saturdays only with additional services as required, during the period from May, 1953 to September, 1959.

Application No. 47. For a U.K. internal seasonal service with DH. 89A aircraft for the carriage of passengers and supplementary freight between Birmingham (Elmdon) and Weston-super-Mare with intermediate traffic stops at Cardiff (if required) at an initial frequency of from four to seven services weekly, during the period from May 23rd, 1953 to October 3rd, 1959.

From Skyways, Ltd. of 11, Berkeley Street, W.1:

Application No. 48. For a Colonial coach service with York Mark 1 aircraft for the carriage of passengers, supplementary freight and mail between London (Stansted) and Kingston (Jamaica) with an intermediate traffic stop at Bermuda at an initial frequency of one service weekly, during the period from 1953 to 1963.

Application No. 49. For a Colonial coach service with York Mark 1 aircraft for the carriage of passengers, supplementary freight and mail between London (Stansted) and Accra (Gold Coast) with intermediate traffic stops at Castel Benito, Kano and Lagos and later possibly Malta, at an initial frequency of from one service fortnightly to one service weekly during the period from April 1st, 1953 to March 31st, 1963.

Application No. 50. For a Colonial coach service with York Mark 1 aircraft for the carriage of passengers, supplementary freight and mail between London (Stansted) and Salisbury (S. Rhodesia) with intermediate traffic stops at Malta, Nicosia, Wadi Halfa, Khartoum, Nairobi and Mombasa, at an initial frequency of one service fortnightly to one service weekly during the period from April 1st, 1953, to March 31st, 1963.

(*Continued on page 32*)

PUBLIC ANNOUNCEMENTS

(Continued from page 31)

Application No. 52 from Airwork, Ltd., of 15, Chesterfield Street, London, W.1, for a Colonial coach service with Viking (VC1) aircraft for the carriage of passengers and supplementary freight between London (Blackbushe) and Malta (Luqa), at an initial frequency of one to three services weekly, during the period from November 1st, 1952, to October 31st, 1959.

Application No. 53: from British Overseas Airways Corporation, of Airways House, Great West Road, Brentford, Middlesex, for a normal scheduled service initially with Hermes aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Nairobi (Eastleigh) with intermediate traffic stops at Rome or other points in Europe—Cairo and Aden, at an initial frequency of once weekly during the period from May, 1952, to April, 1962.

From Olley Air Service, Ltd., of Croydon Airport, Croydon, Surrey:—

Application No. 54: For a U.K. internal seasonal service with DH.89. Dhl. Dove and Consul aircraft for the carriage of passengers, supplementary freight and mail between London (Croydon) and Jersey (C.I.) at a frequency of two services on Fridays and six services on Saturdays during the period from June, 1953, to September 1956.

Application No. 55: for a U.K. internal seasonal service with DH.89. Dhl. Dove and Consul aircraft for the carriage of passengers, supplementary freight and mail between London (Croydon) and Guernsey (C.I.) at a frequency of two services on Fridays and four services on Saturdays during the period from June, 1953, to September, 1959.

Application No. 56: from Silver City Airways, Ltd., of 1, Great Cumberland Place, London, W.1, for the carriage of casual passengers and supplementary freight for the period up to December 31st, 1961, on their vehicle ferry service, at present operated with Bristol Freighter aircraft, between Southampton (Eastleigh) and Cherbourg.

Application No. 57: from British Overseas Airways Corporation, of Airways House, Brentford, Middlesex, for a normal scheduled service initially with Hermes aircraft for the carriage of passengers, supplementary freight and mail between London Airport and Dar-es-Salaam (Tanganyika) with intermediate traffic stops at Rome or other points in Europe—Cairo, Khartoum and Entebbe, and later possibly Nairobi, at a frequency of one to two services weekly during the period from November 7th, 1952, to November 6th, 1962.

Application No. 58: From Aquila Airways, Ltd., of 6, Curzon Place, Park Lane, London, W.1, for a normal scheduled service with Short Solent 2 flying boat aircraft for the carriage of passengers, supplementary freight and mail between Southampton (Marine) and Lisbon (Cabo Ruivo) integrated with their present Southampton-Madeira service, at a frequency of one to two services weekly during the period from December 1st, 1952 to December 31st, 1955.

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30th, 1952. Any representations or objections with regard to these applications must be made in writing, stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 9, Buckingham Gate, London, S.W.1, from who further details of the applications may be obtained. [8721

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SITUATIONS VACANT

The engagement of persons answering these advertisements must be made through the local office of the Ministry of Labour and National Service, etc., if the applicant is a man aged 18-64 or a woman aged 18-59 inclusive, unless he or she or the employer is excepted from the provisions of The Notification of Vacancies Order 1952.

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APPLY in writing to the Employment Manager, Vickers-Armstrongs, Ltd. (Aircraft Section), Weybridge, Surrey.

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WRITE, stating age, qualifications and details of experience, to Staff Officer, Handley Page, Ltd., Cricklewood, London, N.W.2. [8694

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(3) AIRCRAFT DRAUGHTSMEN. Applicants should have good aircraft D.O. experience. Technical qualifications an advantage. (Ref. 120N)

PLEASE write, quoting appropriate reference, and giving full details of qualifications and experience, to Central Personnel Services, English Electric Co., Ltd., 24/30 Gillingham Street, London S.W.1. [8702

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STRESSMEN, senior and junior. Applications are invited from stressmen with degree and considerable aircraft experience for senior post, and degree or equivalent and some aircraft experience for junior vacancies. Good salaries and conditions.—Apply, giving details of age, qualifications and experience, to Chief Designer, Alan Munts and Co., Ltd., Aircraft Division, Langley Aerodrome, Slough, Bucks. [0709]

AIRCRAFT draughtsmen with experience of gun installations required by the Aircraft Division of the English Electric Company, Ltd., at Warton Aerodrome, near Blackpool. Salaries commensurate with qualifications and experience.—Write, with full details, quoting reference 186 to the English Electric Company, Ltd., Central Personnel Services, 24-30, Gillingham Street, London, S.W.1. [0724]

APPLICATIONS are invited from design draughtsmen and stressmen, also technical assistants with combined design and performance experience for work on both reciprocating and gas turbine aero engines.—Applications should state full particulars of experience and qualifications and should be addressed to the Personnel Officer, The de Havilland Engine Co., Ltd., Stag Lane, Edgware, Middlesex. [0602]

ENGLISH ELECTRIC Co., Ltd., require the services of a specialist engineer for thermodynamics and gas dynamics for guided weapons propulsion units. Experience in practical design work and theoretical investigations essential. Only Graduate engineers or physicists can be considered.—Write, with full details, quoting reference 1023, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham Street, London, S.W.1. [0606]

TECHNICAL assistant required for the service department of the de Havilland Engine Co., Ltd. Preferably with experience of reciprocating and gas turbine engines. Suitable applicants will be required to work on headquarters of the service department at Leavesden Aerodrome, Herts.—Apply in writing, stating age, qualifications and salary required, to the Personnel Officer, Leavesden Aerodrome, near Watford, Herts. [0716]

BRITISH EUROPEAN AIRWAYS have a vacancy in their flight operations department for a route facilities officer to specialise in the control of technical publications. Applicants to have current or very recent practical experience of civil aviation operating procedures. The salary scale for this position will range from £595 to £760 p.a.—Apply in writing to Chief Personnel Officer, British European Airways, Keyline House, Rutslip, Middlesex. [0726]

A. V. ROE and Co. require a radio operator for aircrew duties on flight test work at Woodford Aerodrome, Cheshire. Applicants should possess a current P.M.G. radio operator's licence and should be interested in the installation of various types of radio facilities fitted in the present-day aircraft.—Write, giving full particulars of previous experience, age, etc., to the Labour Manager, A. V. Roe and Co., Ltd., Greengate, Middleton, Manchester. [0717]

SENIOR engineer required to be responsible for small engineering laboratory engaged on development of high-grade test equipment in connection with manufacture and maintenance of automatic pilots, aircraft instruments and associated equipment. Work involves the application of electronic techniques over a frequency range from zero to 100 kcs and design experience of light electrical and mechanical assemblies. Preference given to applications from qualified engineers with experience of applied measurements in one or more of the above-mentioned engineering fields.

THE post is permanent with superannuation benefits, carries a salary in accordance with qualifications and experience. Assistance given with housing facilities after a satisfactory probationary period.

APPLY to Personnel Manager, S. Smith and Sons (England), Ltd., Cheltenham, quoting Reference 9/EN. [0706

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STARES controller required by manufacturers of aircraft electrical equipment in the N.W. London area. Applicant must be thoroughly experienced in the scheduling and progressing of spare parts, and be capable of maintaining stock records. Knowledge of Air Ministry Embodiment Loan procedure is essential. This is an excellent opportunity for a man who is a capable correspondent and possesses drive and initiative.—Apply Box 2981. [8713

PROGRESSIVE firm making test equipment for aircraft instruments and undertaking development and manufacture of similar equipment has vacancy for assistant to chief designer. Work will entail outside contact with service and private users of existing equipment in use, and with them and manufacturers on new development. Vacancy should attract well-educated and qualified man with extensive knowledge of aircraft instrumentation and use; practical knowledge of application of electronics methods to instruments essential. Salary in relation to ability and progressive with development.—Write Bryans Aeroquipment, Ltd., Willow Lane, Mitcham Junction, Surrey. [8727

ENGLISH ELECTRIC Co., Ltd., Luton, have a vacancy for an assistant for trials and laboratory work. Duties will include liaison work on guided weapons propulsion unit, trials and also experimental laboratory work. Previous experience in mechanical or hydraulic testing would be useful. Applicants should have a minimum technical qualification of Inter. B.Sc. or O.N.C. Write, with full details, quoting reference 1085, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham Street, London, S.W.1. [8698

C.A.V., Ltd., have a vacancy in their research dept. for a graduate, preferably with an honours degree in mathematics, to undertake mathematical studies of hydraulic stress and thermodynamic phenomena relating to diesel engine research. Salary for the above appointment according to ability and experience, £550 to £750 p.a. The appointment will include participation in a pension scheme, and affords considerable opportunities for advancement.—Applications should be addressed to the Personnel Manager, C.A.V., Ltd., Acton, W.3. [8720

ENGLISH ELECTRIC Co., Ltd., Luton, require contract engineer, preferably with experience of car or aircraft industry, as head of contracts section of their division engaged on guided weapons project at Luton. New and interesting field of work and the candidate will be expected to display initiative and accept responsibility. Requirement calls for sound commercial background, previous employment on contracts side of industry plus experience if possible in dealing with Government departments. Salary £700 upwards, according to qualifications. Staff pension scheme.—Write, with full details, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham Street, London, S.W.1. [8696

ENGLISH ELECTRIC Co., Ltd., Luton, have a vacancy for a research engineer for work on planning and analysis of supersonic flight tests. Applicants should have a degree, Higher National Certificate or equivalent qualifications. Previous experience of stability and control work an advantage, but not essential.—Write, with full details, quoting reference 441J, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham Street, London, S.W.1. [8695

DESIGN engineer required by The English Electric Co., Ltd., Luton, capable of carrying out detailed design work on guided weapon propulsion units. Previous drawing office experience essential. Experience of thermodynamics engineering an advantage, but not essential. A minimum technical qualification of O.N.C. or Inter. B.Sc. is required.—Write, with full details, quoting reference 1094, to Central Personnel Services, English Electric Co., Ltd., 24/30, Gillingham Street, London, S.W.1. [8697

BRITISH EUROPEAN AIRWAYS require draughtsmen to work on modification and repair of aircraft at Renfrew. Applicants should have served an apprenticeship in aeronautical engineering and possess Higher National Certificate, or equivalent, in mechanical or electrical engineering. A sound knowledge of aircraft structures and workshop practice is essential. One post is for a man who has specialised in electrical and radio work. After qualifying periods, pension, insurance and sick pay schemes, generous holidays and air travel concessions. Salary for man aged 25 years and over, not less than £9 15s. 0d. per week.—Applications, in writing, to Base Personnel Officer, B.E.A., Renfrew, Scotland. [8722

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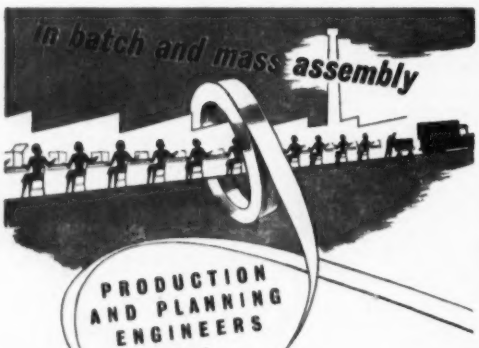

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Photograph of the "Bristol" Britannia at take-off for its maiden flight — Filton, Saturday August 16th, 1952.

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